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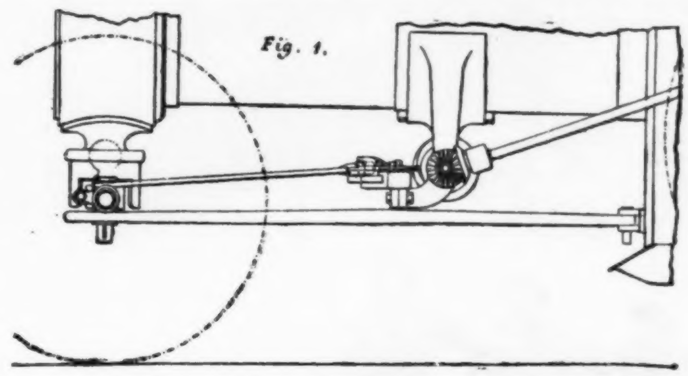
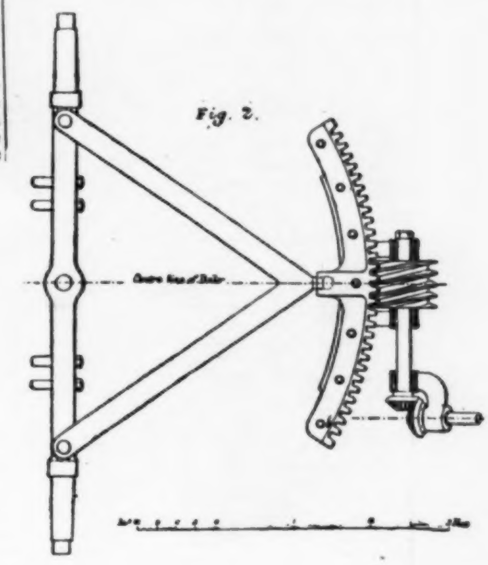
NEW TRACTION ENGINE.

THE annual Show of the Royal Agricultural Society of England this year was held in Liverpool. Amongst the traction engines the chief novelty shown at Messrs. Fowler's stand was the traction engine of which we give an engraving. The engine is rated as a 6-horse, and as will be seen from our engraving, it has a pair of cylinders, these being 5¾ in. in diameter with 10 in. stroke. The normal number of revolutions for the crankshaft is 180 per minute, and with this speed the engine travels at 1¼ miles per hour when in the slow-speed gear, and 2½ miles per hour in the quick-speed gear. The ratio between the speed of the piston and peripheral velocity of the driving wheels is thus 2.727 to 1 for the slow and 1.363 to 1 for the quick speed. The driving wheels are 7 ft. in diameter and 12 in. wide on the rim, while the leading wheels are 3 ft. 6 in. in diameter with a width of rim of 9 in. The distance between the centres of the leading and hind wheels is 9 ft. 8½ in., and the length of the engine over all is 15 ft. 8 in. The boiler is worked at a pressure of 100 lb. per square inch, and the total weight of the engine in working order is 8 tons 15 cwt. The driving wheels run loose on the axle, and differential gear is provided on the second motion shaft to facilitate the turning of the engine. The engine is fitted with a crane at the leading end, the hoisting drum being situated on a shaft under the barrel of the boiler, and this shaft being driven by means of a vertical shaft, which will be seen in our engraving, on the left-hand side of the engine. The vertical shaft is driven from the crankshaft by bevel gear, and at its lower end it carries a worm which gears into a worm-wheel on the hoisting drum shaft. Besides the hoisting drum this latter shaft also carries a winding drum on the rig -hand side of the engine, this drum containing 100 yards of steel wire rope. By means of this rope the engine can haul cannon, &c., out of difficult places, while by connecting the rope to an anchor or some fixed object the engine can haul itself out of a hole or up gradients which it could not otherwise surmount. A clutch worked by a hand lever serves to connect either the crane drum or the hauling drum with the shaft on which they are carried. The crank and intermediate shaft bearings as well as that at the upper end of the upright shaft, are carried by wrought-iron brackets firmly bolted to the boiler. The fly-wheel is small, and the working parts are covered by a casing not shown in our engraving. Messrs. Fowler informs us that the engine we have been describing will readily ascend inclines of 1 in 6, while it will take a load of eight tons up a gradient of 1 in 10, or draw 20 tons on the level. The boiler of this engine, as well as the gear and shafts, is made of steel.

Beside the large-wheeled engine of which we have just been speaking, Messrs. Fowler also show two other traction engines—an 8-horse and a 6-horse—of the following dimensions:

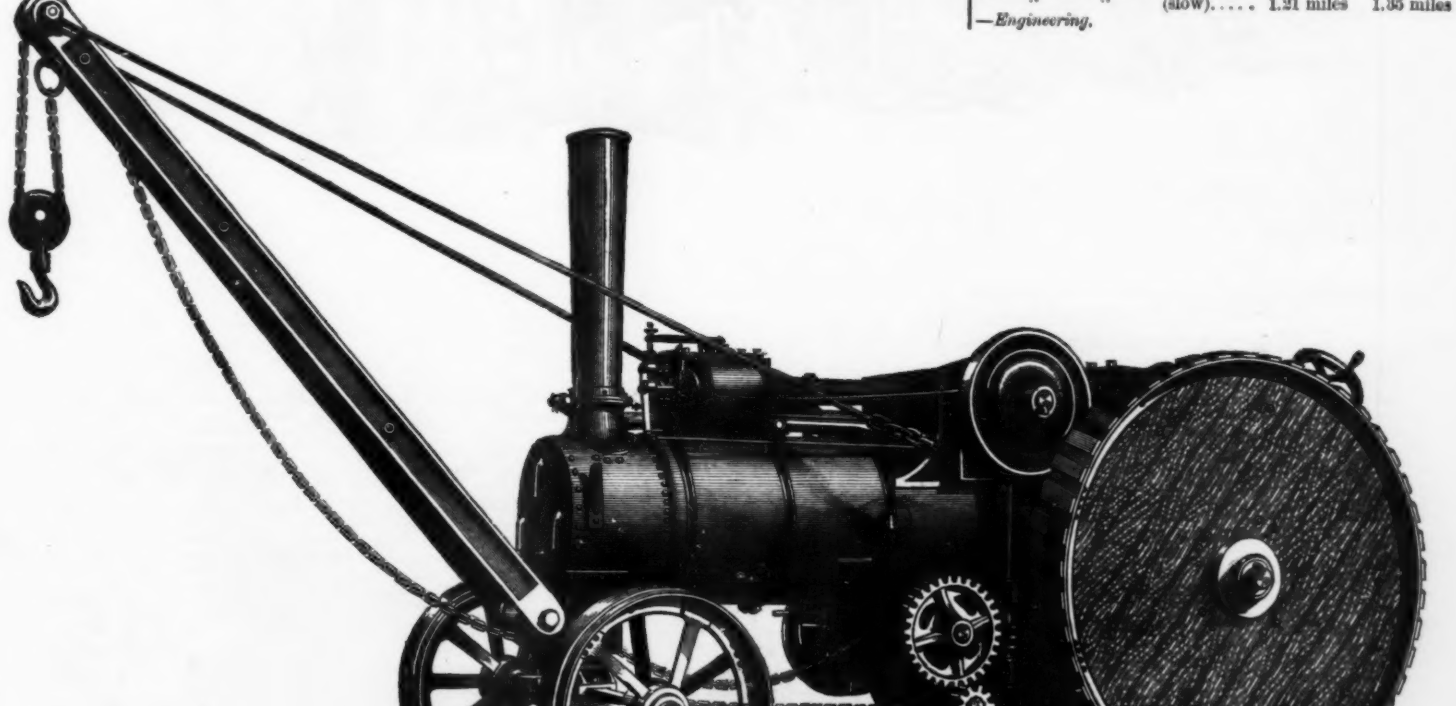




STEERING GEAR FOR TRACTION ENGINE.

Nominal horse power	8 horse	6 horse
Diameter of cylinder	9 in.	7½ in.
Stroke of piston	12 in.	10 in.
Total heating surface	135 sq. ft.	100 sq. ft.
Average steam pressure	100 lb.	100 lb.
Number of revolutions per minute	150 rev.	160 rev.
Diameter of fly-wheel	4 ft. 6 in.	3 ft. 9 in.
" driving wheels	5 ft. 6 in.	5 ft.
Width of " "	16 in.	12 in.
Speed of road motion (quick)	2½ miles	2.69 miles
" " (slow)	1.21 miles	1.35 miles

—*Engineering.*



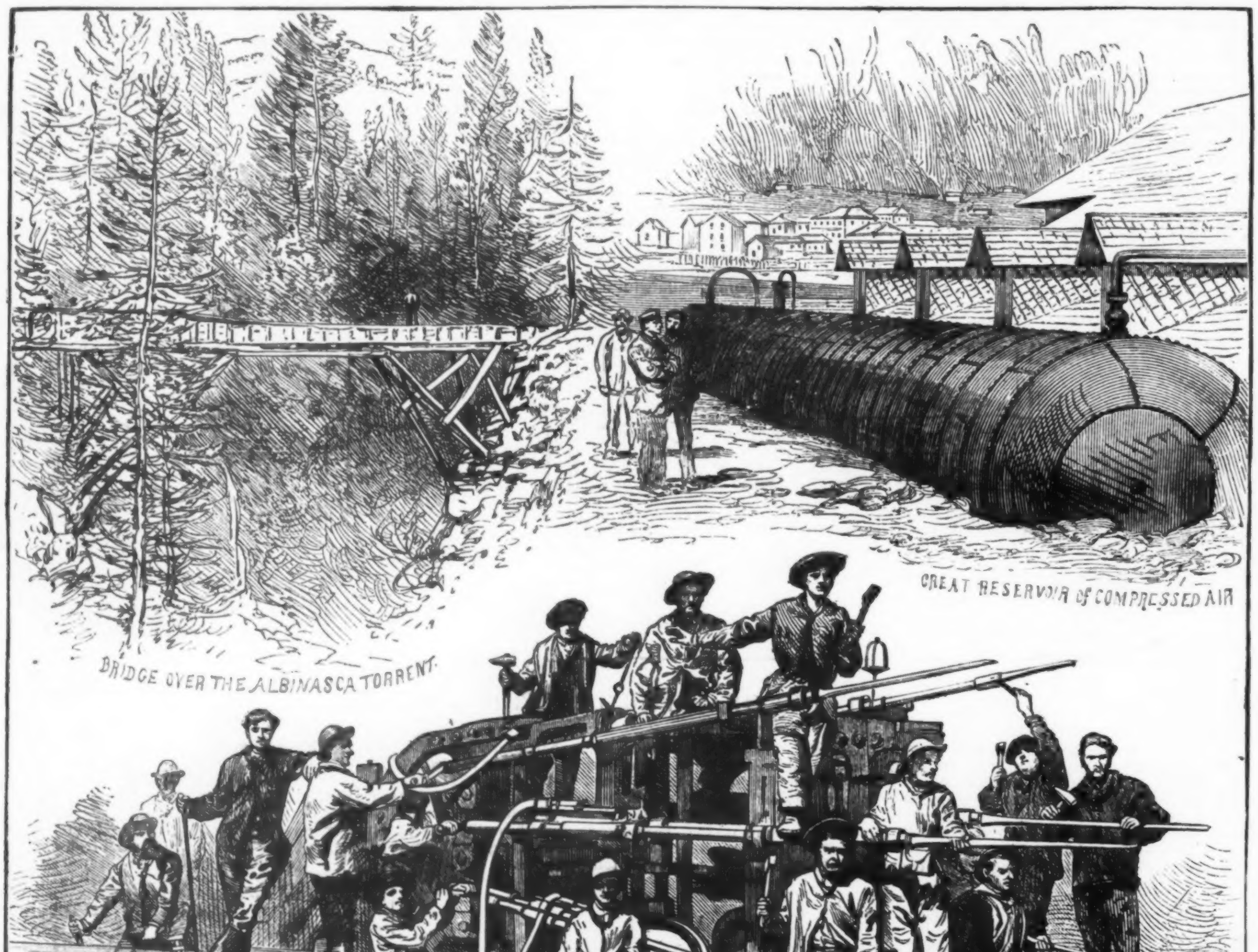
NEW SIX HORSE POWER TRACTION ENGINE. BY J. FOWLER & CO.

THE ST. GOTHARD TUNNEL.

In the very center of that stupendous barrier of mountain ranges, called the Alps, which shuts off Italy from Switzerland, and from Savoy and the Austrian Tyrol on each hand, stretching to the Gulf of Genoa and to the Adriatic, a gigantic engineering work is about to be recommenced. The construction of the St. Gothard railway tunnel is not less important, we consider, than that of the Mont Cenis Tunnel, connecting Savoy and France with Piedmont and the western and central provinces of the Italian kingdom. It will afford more direct and independent communication, not only between Germany and Italy, but also between England and Italy; while Switzerland, Belgium, and the whole of Central and Northern Europe will obtain immediate access to the Mediterranean and to its ports for trade with the Levant. We observe, therefore, with satisfaction, that an International Conference, lately held to debate upon the means of raising sufficient capital, by joint contributions from several countries interested in the project, has agreed upon a fair division of the cost. Our illustrations of the works that lately underwent a temporary suspension, from obstacles of a pecuniary kind, were prepared some time ago from a series of photographs which an official gentleman had sent us, accompanied by his own description of the subject. The following is a translation of his account of it:

"Between the Simplon, to the west, and the Lukmanier and Splügen, in the Grisons, to the east of it, rises the St. Gothard clump of mountains, the elevation of which is above the line of perpetual snow. It contains the sources of the Rhine and the Rhone, as well as of the Reuss and the Tessin or Ticino; but the two last-named rivers occupy, respectively, the northern and the southern valley, on the Swiss and the Italian side of the St. Gothard; the former pursuing its course to the Lake of the Four Cantons, the latter flowing down into Lake Maggiore.

"The proposed tunnel through the St. Gothard will be of the length of 15 kilometres, which is about nine miles and one-third of a mile. Its north entrance is situated below the village of Goschenen, a dreary hamlet in the Canton of Uri, which was only, during a few summer weeks, enlivened by the visits of foreign tourists on their way to see the Furka Glacier, or taking the St. Gothard Pass for their route to Italy. Before the commencement of the tunnel works, Goschenen consisted of about 60 dilapidated houses, irregu-



THE ST. GOTHARD RAILWAY TUNNEL WORKS.

larly stuck against the rocks, or huge blocks of granite, and moraines of a receding glacier, at the foot of the mountain, below the bridge over the Reuss. It has been changed into a scene of bustle and activity; within three years past a new town has been created, for the accommodation of two thousand laboring men; there are comfortable hotels, a post office and telegraph, and the visitor may enjoy musical entertainments or dancing, or the reading of his newspaper, as in any fashionable place of resort on the Alps. But the sights and sounds of strenuous toil are continually present. The detonation of a mine exploded in the bowels of the rock, or the shrill whistle, rattle, and rumble of a locomotive engine, the cries of Piedmontese laborers, or their songs, perhaps Garibaldi's hymn, when coming back in the evening, after a day's hard work, remind us that this is no mere place of holiday recreation or of repose for invalids. The first sight of the great work is gained in leaving the village, just below the commencement of the steep side path up the narrow Schöllenen defile. Here is the dark archway that marks the northern entrance to the tunnel, and here on the river bank, are the buildings, the lines of railroad or tramroad, the wagons and trucks, the blocks of stone and tubes or beams of iron, and various parts of machinery, to be adjusted by the workmen. (We give an illustration of the north end of the tunnel at Goschenen, and one likewise of the south end, which is at the village of Airolo, in the Canton of Ticino, on the Italian side of the mountain).

"An inspection of the St. Gothard line of railway, from Lucerne, at the upper end of the Lake of the Four Cantons, to Goschenen, and thence by the tunnel to Airolo, shows what great difficulties it has had to encounter. The Lake of the Four Cantons (the Vierwaldstattersee) is 1,430 ft. above the level of the sea, while Goschenen 3,630 ft.; so that there is a difference of 2,200 ft., which incline has to be overcome by the steepest possible gradients; and from Airolo to the Lago Maggiore there is a very steep descent. Without reckoning the nine miles of the great tunnel, there are other tunnels, having an aggregate length of 16 or 17 miles, in different portions of the railway. The entire length of the line, from Lucerne to the Italian frontier, traversing the Swiss Cantons of Lucerne, Zug, Schwytz, Uri, and Ticino, is about 163 miles. It appears, from the Chief Engineer Helwag's report to the Federal Council of Switzerland, that the cost of laying the line, which was at first estimated at 187,000,000 francs, cannot be less than 289,000,000. The contractor, M. Louis Favre, has sublet the contract for boring the great tunnel, without the internal casing of masonry, at the rate of 2,800 francs the longitudinal metre, for the 15,000 metres of its total length. Add to this cost of boring and excavating ten or twelve million francs for the masonry, and we get a sum of from fifty-two or fifty-three million francs for the cased tunnel; but to this we must add eight or nine millions for the finishing and for laying down the permanent way, as well as for plans and surveys, engineering superintendence, and management of the works, bringing up the entire cost of the St. Gothard tunnel to sixty-two or sixty-five millions of francs. It is a large sum, equivalent to some two millions and a half pounds sterling; yet very much less than the actual cost of two great recent works of a similar nature. The tunnel through the Col de Fréjus, commonly known as the Mont Cenis Tunnel, which is 12,233 metres long, cost about 75,000,000f., and the Hoosac tunnel in Massachusetts, with a length of 7,634 metres, cost more than 6,000f. the metre. The vast progress mechanical science and skill in late years has been nowhere proved more remarkably than in such undertakings as these. The old implements of excavation, pickaxe, chisel and mallet, were superseded in the Mont Cenis tunnel by a new instrument, the perforator, which attacks the hardest rock-surface by percussion; and a newly applied motive-force, that of compressed air, which had previously been little understood, was there brought into action. These two special inventions of machinery are now indispensable for the work of such tunnels as the Mont Cenis, the St. Gothard, or the projected British Channel submarine tunnel. Improvements have been made in their details, and their organism has been perfected. But their original type has been preserved. The condensed air, when it passes from the cylinder in which it suffers compression, is transmitted by cast-iron tubes, of a diameter varying in different cases, to those places in the excavation where its power is needed for attacking the face of the rock. It is there used for setting in motion the perforators that strike the rock, and which pierce in it the holes for inserting the charges of dynamite. These charges are exploded, and the fragments or mass of stone thus detached from the rock are then carried away and deposited outside the tunnel. The perforating machine has been sheltered during the explosion, in a siding made in the rock, at such a distance as not to receive any damage. It is now again brought forward in front of the rock to be cut through; the conduit of compressed air is re-attached to its motive-power apparatus, and fresh holes are bored to serve for another blasting operation. Such is the work of excavation, very simple in principle, but complex and minute in its various details.

"Outside the entrance to the St. Gothard tunnel we meet with the air-compressing apparatus, which is fitted up on the Colladon system. Twenty-three cylinders, at each end of the tunnel, at Goschenen and at Airolo, are worked to compress 1,200 cubic metres of air (1,596 cubic yards) to a density eight times that of the atmosphere. The air-condensers are set in motion by water power, which is applied by six Girard turbines, the water being supplied by canals; it flows down through the Val de Schöllenen to Goschenen, but on the south side of it is drawn from the Tremola and the Ticino, by a system of locks and reservoirs. The precipitous clefts in the rocks are frequently crossed by the water pipes, suspended at a giddy height, or supported by a light wooden bridge, which is seen at the place where the Ticino conduit passes over the Albinasca, to supply the turbines that work the air-condensing apparatus at Airolo. [This is shown in one of our illustrations.]

"An army of nearly two thousand workmen, miners, smiths, carpenters, and engineers, is employed constantly at each of the two ends of the tunnel, to perform this vast undertaking. It is a scene of great activity when they are all working there. At the sheds for repairing the machines there lie a great number of perforators, all blunted or bent in their hard service, pieces of their carriages, and other parts of the boring apparatus; behind these are the forges, with their blazing fires, where the points and edges of the augers and the chisels are sharpened and re-tempered; not far off is heard the dull thumping beat of the huge hammer, plied by an engine of sufficient power; in the distance, among heaps of earth and stone fetched out of the mountain, stand the powder magazines and factories of dynamite cartridges for blasting the rock. We observe also the canteens or refreshment booths, the rows of lodging houses, the hospital, the carpenters' and wheelwrights' workshops; and we have to step over the air tubes and water pipes, extending from the outside far into the tunnel. Overhead, at the tunnel's mouth, is fixed the ventilating apparatus to purify the air of the interior, so often fouled by the mining explosions.

"The St. Gothard tunnel, like others designed for the accommodation of a large traffic, is made to admit two lines of railway. Its dimensions, in a diametrical section, are nearly eight metres wide and seven metres high, making an opening of between forty and fifty metres square. The excavation of this space in the perpendicular face of the rock is divided into several different sections. These are penetrated simultaneously by an adequate number of piercing implements, each mounted on a solid iron frame, with screws and levers by which it can be set at the required height, to strike directly forward or obliquely, as may be found expedient. The largest carriage or frame, used in the principal level cutting, is about four metres long, and stands one metre and a half in height, carrying six perforators of the MacKean sort; those used at the north end are of the Ferroux pattern. Each of these movable machines is tended by three men, who are occupied with its transportation, and with the replacing, fixing, and using of the perforators upon it, or the pouring of water into the holes that are bored, to facilitate their work. A tender follows the engine, with a supply of water to be injected for this purpose.

"The number and depth of the holes to be bored, and the amount of work to be done by the performers, must depend on the nature of the rock, and the position of its strata, being more or less favorable to its removal by blasting. The greatest difficulty is found in first opening the small top section of the tunnel's diameter, and picking out the solid rock in that part, while all the substance of the adjacent sections is still intact. In the granite rock at Goschenen, to lay open a space of six or seven metres square, it was needful that from twenty-two to twenty-six holes should be bored in its face; whereas twelve holes were sufficient for the schistose gneiss found in other portions. The granite, which extends here from the Finster-aarhorn, has a lateral thickness of 2,000 metres, intersecting the axis of the St. Gothard tunnel. The depth of the holes bored varies from 80 centimetres, in the schists, crystalline, micaceous, or talcose, to 1 metre 20 centimetres, its maximum depth in the granitic rocks. The dose of dynamite used for blasting is about one kilogramme in each of these holes. The whole daily consumption of that explosive compound, at both ends of the tunnel, is more than 500 kilogrammes. Instantly after firing the charge in these holes the mass of stone and other substance detached by it is carried away in trucks or wagons, drawn by a condensed-air locomotive, to be deposited outside the tunnel. The quantity so brought out is about 400 cubic metres in 24 hours. Each wagon conveys at one time an average load of one cubic metre. Besides the number of wagons so employed, fifty others are in constant requisition for transporting fresh supplies of boring chisels and other implements, and bricks for the internal masonry of the tunnel arch.

"The combined, or rather consecutive process of boring, blasting, and removing the substance detached from the interior of the mountain are together called making a poste, or stage, in the progress of the work. Each stage is supposed, in general, to advance the work of opening the tunnel from one metre to one metre twenty centimetres in length. In a good easy piece of rock, suitable for boring and blasting, three or four stages can be accomplished in a day, making progress to the extent of from 3m. 50c. to 4m. 50c. At this rate, working equally at both ends of the tunnel, its construction would advance from seven to nine metres daily, if not hindered by unfavorable circumstances. Unfortunately, there are frequent hindrances and inevitable causes of delay. Violent inbursts of water, in jets as large as the thickness of a man's arm, spouting from the rock with enormous force, have overturned the machines, dispersed or nearly drowned the laborers, and flooded the levels. Compact blocks of crystallized granite, two or three yards thick, have resisted the perforators, breaking the tools, dislocating the machinery, and have scarcely yielded to the force of dynamite. In another place, there is a loose, soft, clayey stratum, which hardly bears the stroke of the boring apparatus, and needs timber props to keep it from falling in and burying all at once. The hard rock, the crumbling earth, and the irruption of water, have successively threatened to stop this great work; but its safe accomplishment is only a question of time.

"The St. Gothard tunnel was begun at Airolo, its south entrance, in September, 1872, and at Goschenen, the north end, in November of the same year. It had been excavated, to the length of more than eight kilometres, adding together the lengths done at both ends, in April, 1876, when a length of 6,858 metres still remained to be excavated. There was a considerable difference, however, in the conditions of this task at the north and at the south end. The excavation from Goschenen was scarcely ever interrupted, as the rock was solid, not requiring any props, and with no serious discharge of water; but there were very great difficulties in the excavation from Airolo. The discharge or infiltration of water increased from the amount of 42 litres in a second, at which it was estimated in May, 1873, in the talcose and granular mica-schists of that locality, to about 200 litres a second (44 gallons) in December of that year. The face of the rock directly attacked by the perforators alone yielded 40 litres of water in every second of time. In January, 1874, the whole amount continually pouring forth was at the rate of from 230 to 250 litres per second; and this frightful state of things continued throughout the year. By degrees, however, the rock seemed to become drier; but the works were still flooded, and many laborious hours and days were lost in attempting to cope with the influx of waters, to clear away the stuff they washed down, and to support the roof and sides of the tunnel. The timber scaffolding erected for this last-named purpose may yet be seen, in passing through the miles of tunnel already opened by the workmen. But the St. Gothard as well as the Mont Cenis tunnel will before very long, we may hope, be made a convenient passage for the railway trains, conveying passengers and merchandise from the busy and wealthy countries of Europe to the north of Italy, and thence onward to the Levant, the Suez Canal, and the Indian Ocean."—*Illustrated London News.*

SHOOTING UNDER WATER.

Major-General von Uchatius, the inventor of the new field gun adopted in the Austrian army, publishes in the Vienna *Artillery and Engineer Journal* an account of some interesting experiments recently made by him with the object of ascertaining the effect produced by firing a rifle under water.

It is known, he says, that fishes, when they are not too much below the surface of the water, can be shot from the shore or from a boat. The armor plates of ships of war, however, do not usually extend any lower than from two to three meters below the surface, as beyond that depth ships are regarded as unassailable even by the largest shot. This is so, no doubt, when the shot is fired above water; but Major-General von Uchatius wished to find the result which would be attained by firing under water.

For this purpose he procured a wooden raft, to the under surface of which a Werndl rifle was attached with iron clamps in such a manner that when the raft floated on the water the rifle was fixed horizontally at a depth of half a meter below the surface. An attendant then opened the lock, introduced a cartridge, placed the rifle at full cock, and fired it from the shore by means of a string attached to the trigger. The target consisted of a wooden board an inch thick.

The result of the experiment was as follows: There was no difficulty in loading and firing the rifle, and there was the advantage that after each shot the inside of the barrel was cleaned by the water. About thirty shots were fired without the smallest damage to any part of the rifle. At each shot there was a dull sound, which could not be heard beyond a distance of fifty paces, and bubbles of smoke rose above the surface. At a distance of one and a half meters no impression whatever was produced on the target; at one and a quarter meters the bullet entered to a depth of from three to four millimeters, and at one meter the target was pierced through.

Major-General Uchatius also made some experiments with the view of ascertaining whether a greater effect could be produced by corking up the barrel at its mouth so as to keep the water out, and thereby diminish the resistance to the egress of the bullet; but he found that for all practical purposes the resistance of the compressed air in the barrel was equal to that of the water, the target being penetrated only at a maximum distance of a meter, as in the previous experiment.

MEASURING MACHINES.

It is hardly too much to say that the power of producing true surfaces lies at the bottom of all machine construction. When Watt first constructed his steam engine, one of his great difficulties consisted in making the piston fit true to the cylinder. Such extreme precision has, however, since been obtained that we are now able to detect the difference of fit in two pistons though they may not differ by more than the ten-thousandth of an inch in diameter. This great advance in the construction of machinery of precision is due mainly to the exertions and ingenuity of Sir Joseph Whitworth, who has spared no pains to effect improvements in this direction. His steel "surface plates" are indeed the nearest approach to absolutely true planes which human ingenuity has yet contrived. So true, in fact, are these surfaces that if a piece of gold leaf be rubbed between them it entirely disappears, its molecules being forced into the pores of the steel. Sir Joseph's standard gauges are likewise marvels of mechanical skill. Professors Goodeve and Shelley have therefore rendered no small service to students of mechanics by putting before them clear descriptions of these instruments of precision, but above all by describing the beautiful measuring machine with which the name of Whitworth will always be associated.

There are two ways in which minute linear magnitudes may be gauged; one being the old method of measurement by means of the micrometer and microscope; the other being the method of "end measurement," which relies upon truth of surface and delicacy of touch. The latter is the principle on which the Whitworth machine is based. At first sight it may seem strange that minute differences of magnitude should be more readily detected by the sense of feeling than by the eye aided by the microscope. Yet Sir J. Whitworth has shown beyond doubt that this is the case. Workmen in securing a good mechanical fit usually depend on touch, and the "feeling piece" attached to the Whitworth machine can be manipulated with extreme delicacy.

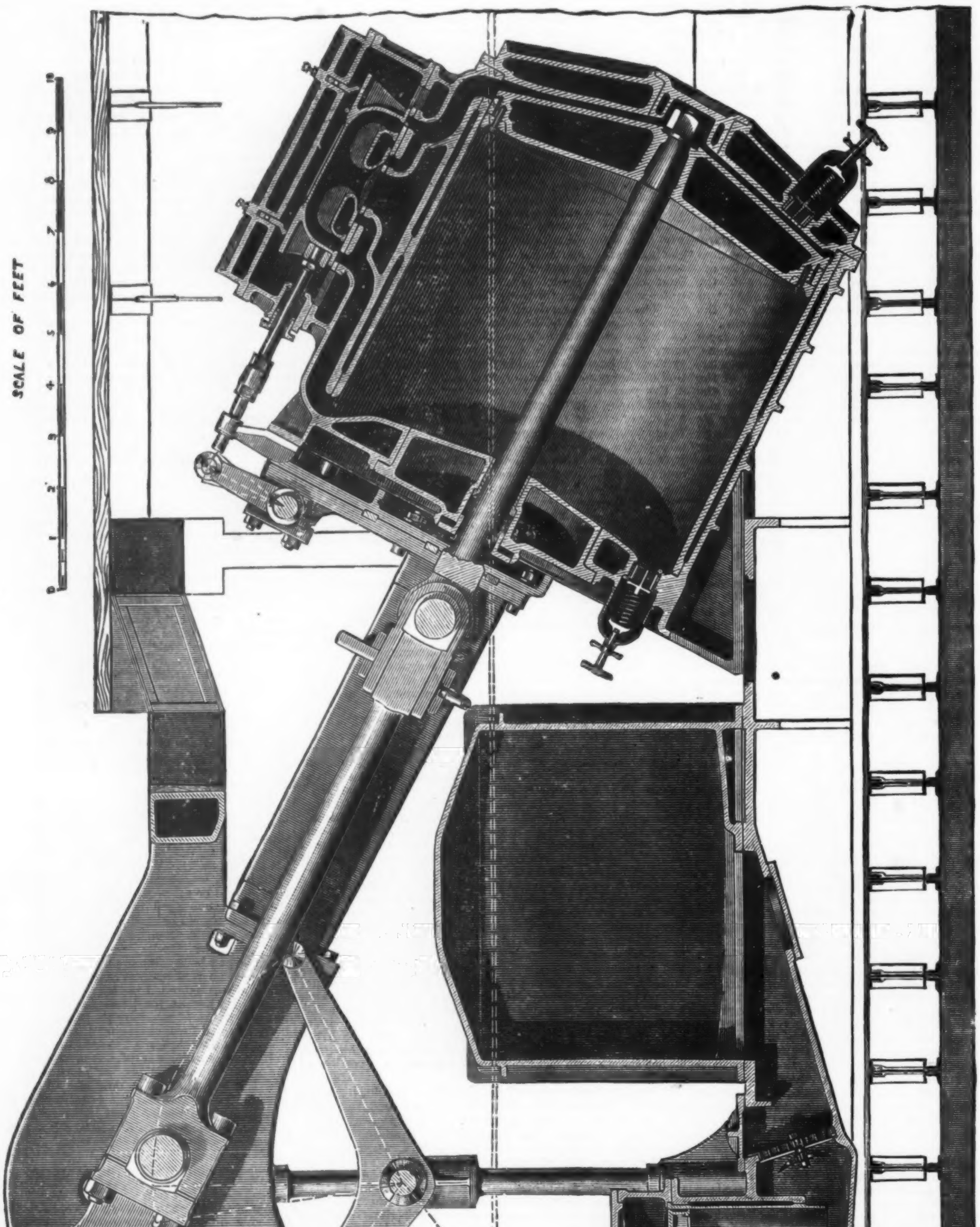
It must be remembered that Sir Joseph's measuring machine is not intended so much for measuring the actual length of a bar as for determining very minute differences in the lengths of specially prepared bars; hence it is peculiarly adapted for multiplying copies of standards of length. For use in a workshop a Whitworth machine is constructed to indicate a difference of one-thousandth of an inch; but the great triumph is the far more delicate instrument by which a difference of a millionth of an inch may be detected. To understand the construction of this beautiful instrument the reader must refer to the series of plates attached to the work of Professors Goodeve and Shelley.—*Popular Science Review.*

ENGINES OF THE STEAMSHIPS LIMERICK, MILFORD, AND WATERFORD.

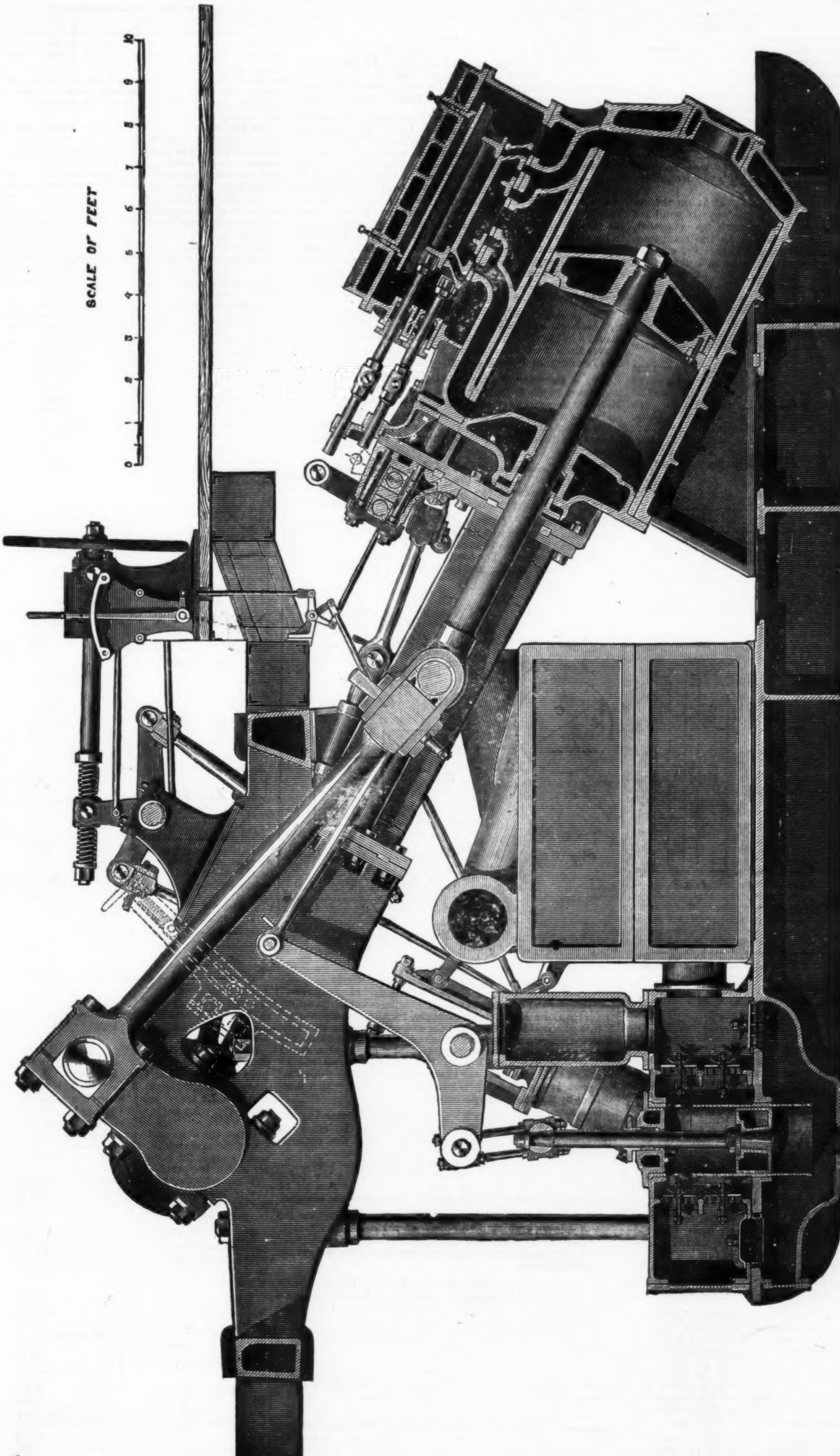
We give in our Supplement, No. 85, general drawings of the new mail steamers constructed by Messrs. Simons, of Renfrew, to the order of the Great Western Railway Company, for their Irish traffic between Milford and Waterford. We now give drawings of the compound paddle engines of these boats, with the principal dimensions of the boats and their machinery. The length of the boats between perpendiculars is 251 ft. 8 in.; breadth of beam, 29ft. 2 in.; depth of hold, 15 ft. 2 in.; gross tonnage, 1,000. They have each two compound high and low pressure engines, with surface condenser; high pressure cylinders, 52 in. diameter, low pressure cylinder, 90 in. diameter, both cylinders steam jacketed and length of stroke of each 6 ft., fitted with double ported equilibrium slide valves worked by link motion, ports double, high pressure, 2½ in. by 45 in., low pressure 2½ in. by 75 in. in the cylinders respectively; piston rods, 9 in. diameter; connecting rods, 10 in. diameter at middle and 12 ft. long; air pump, 3 ft. diameter, single acting, stroke 33 in.; air pump rod, 4½ in. diameter, of tough brass; circulating pump, 18 in. diameter, double acting, stroke 33 in.; circulating pump rod, 4½ in. diameter, of tough brass; main shaft journals, 16½ in. by 25 in. long, inboard; paddle shaft journals, 18 in. by 36 in. at wing brackets; main valve spindles, double, 3 in. diameter; expansion valve spindles, 2½ in. diameter. Steam starting and reversing gear, cylinders 16 in. diameter, 21 in. stroke. Crank pins, 11 in. diameter. Paddle wheels, 24 feet diameter, ten floats each 8½ ft. by 3½ ft. on each wheel.

Steam is supplied by two circular boilers, each 13 ft. diameter and 17 ft. 6 in. long; steam chests, two, 4 ft. diameter and 17 ft. long; boiler heating surface, 6,200 square ft.; fire grate surface, 235 square ft.; condensing surface, 4,000 square ft.; working pressure, 65 lb.—*The Engineer.*

Gold-leaf is beat out so thin that fifty square inches of it weigh only a grain; one grain of gold, however, of the thinness which it is upon silver wire, will cover an area of 1,400 square miles.



COMPOUND ENGINES OF THE MAIL STEAMERS LIMERICK, MILFORD, AND WATERFORD.



COMPOUND ENGINES OF THE MAIL STEAMERS LIMERICK, MILFORD, AND WATERFORD.

HOW TO USE THE CARPENTER'S SQUARE.

By JOHN O'CONNELL, Millwright, St. Louis, Mo.

The Framing Square.—The long arm of the square is called the blade, the short arm the tongue. The diagonal scale on the tongue at the junction with blade, Fig. 1, is for taking off hundredths of an inch. The lengths of the lines between the diagonal *de*, and the perpendicular *ef*, are marked on the latter. To take off 3 tenths and 4 hundredths of an inch, place the compasses on the dots on the fourth line. 7 tenths and 3 hundredths of an inch is shown on line 3; 1 inch 8 tenths 5 hundredths, is the distance indicated on line 5.

The brace scale is immediately below the diagonal scale, on the tongue. The equal numbers placed one above the other represent the sides of a square, and the 80·61, with the other numbers similarly placed, the diagonals. The exact length of a brace with a run of 57 in. on a post, and the same distance on a beam is 80·61 in. This is the length between shoulders.

The octagonal scale is shown by Fig. 3. It is on the opposite side of the tongue. It is used in this way: If you have a stick 10 in. square which you wish to dress up octagonal, make a centre mark on each face, then with the compasses take 10 of the spaces marked by the short cross lines in the middle of the scale, and lay off this distance each side of the center lines. Do the same at the other end of the stick, and strike a chalk line through these marks. Dress off the corners to these lines, and the stick will be octagonal. If the stick is not straight it must be gauged, and not marked with the chalk line. Always take a number of spaces equal to the square width of the octagon in inches. This scale can be used for large octagons by doubling or trebling the measurements.

The vertical rows of figures on the blade, Fig. 1, form what is called board measure. The superficial contents of a board are found thus: Suppose the board to be 13 ft. long and 15 in. wide. Look for 13 under the 12 in. mark on the inch scale; follow the line this 13 occupies, till under the 15 in. mark, the answer, 16 ft. 3 in., is found. Some squares have the board measure arranged as in Fig. 2, without the fractional parts of a foot. On these the answer is found in the same manner; the difference being that the answer gives feet only, and not inches.

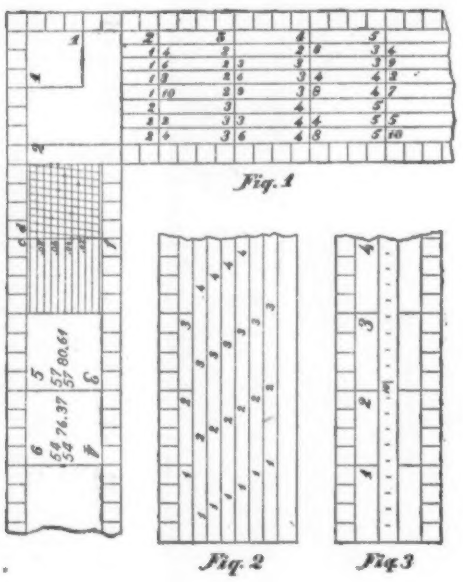


Fig. 1 Fig. 2 Fig. 3

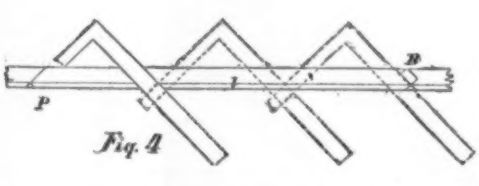


Fig. 4

Beside these, the most complete squares contain a diagonal scale of 1½ in. to the foot, showing feet, inches, and sixteenths of an inch. One hundred and ninety secondths of 1½ in. are also shown on this scale. There is another diagonal scale, dividing the inch into twelfths and one hundred and twentieths, and a scale of half a foot divided into 5 parts. On one side of this scale are the usual inches and eighths. So by comparing these scales, decimals of a foot are easily resolved into inches or *vice versa*.

To find the Lengths and Bevels of Braces and Rafters when the Rise and Run are given.—Fig. 4. Take, for example, a brace of which the rise and run are equal, or what is called a square brace. Lay the square on the stick at the 12 in. mark on both blade and tongue. Draw a line along the tongue; this is the bevel for one end of the brace. Mark the edge of the stick along the blade; and move the square along, bringing the 12 in. mark on the tongue to the point where the 12 in. mark on the blade was before. This movement performed three times gives the precise length of a brace with 3 ft. rise and run. 18 in. and 18 in. taken twice, or 9 in. and 9 in. taken four times, gives the same lengths and bevels.

The length we have found is the distance between the shoulders; the tenons must be allowed for with this. One tenon is laid off at B. Sometimes braces are let into the posts ½ or ¼ in. or so. In that case the point of the brace, as shown at P, must be cut off square with the bevel of the brace. Whatever distance a brace is let in, this distance must be gauged from the edge of the stick, as shown by the gauge line, *l*. In this case, the length of the brace must be measured on this line. When braces are made without tenons they may be worked from the edge, of course.

To find the number of inches to take on Blade and Tongue for a given rise and run of a Brace.—Divide the shorter rise or run of the brace or rafter into a number of equal parts, each part not to exceed the length of the tongue of the square. Divide the longer rise or run into the same number of parts, each part not to exceed the length of the blade, and if it does, divide the shorter rise or run into a greater number of parts. Example: A rafter with a run of 10 ft., and a rise of 6, 12 in. on tongue and 20 on blade taken six times will give the length and bevels; or 15 and 9, taken eight times. When a brace or rafter is too long to be conveniently worked in this way, take a half or a third of both rise and run, and take two or three times the answer.

When you find the number of inches to take on the square, lay the latter on a straight edge or line, and find what diagonal length it gives. This, multiplied by the number of parts in rise or run, gives the whole length of brace.

To find a Circle equal in area to two or more Circles.—Fig. 5. Let A be ¾ in. in diameter, and B, 1¼ in. Measure across from the ¾ in. on one arm of the square to the 1¼ in. on the other; this distance is the diameter of the required circle, C. If there were three circles, we should set the diameter of the third on the tongue and that of C on the blade; and the diagonal distance between these points would be the diameter of a circle equal to the three, and so on for any number. This applies to squares also. By this simple rule we can find the size of one pipe equal to two or more, and square spouts in like manner. Similar figures of all kinds may be worked by this method—triangles, rectangles, hexagons, octagons, etc., taking similar dimensions only, that is, if the shortest side of one triangle is taken, the shortest side of the other must be taken also, and the answer gives the shortest side of the required triangle.

Three points not in a straight line being given, to find the center of a circle which will pass through them.—Fig. 6. Let 1, 2, and 3 be the points. Connect them by straight lines, and square from half the distance between them as at *d* and *e*. The intersection of these perpendiculars is the center.

To find the center of a circle with the square.—Fig. 7. Lay the square on the circle with the corner at the circumference. Mark where outer edge of tongue and blade cut the circle, and draw a line connecting these points. This line is always a diameter, and by drawing in like manner a diameter in another direction, the intersection of the two gives the center.

To find the side of a square of half the area of a given square.—Fig. 8. Let G be the given square; half its diagonal gives the side of the smaller square. A square constructed on the diagonal of G, would contain double the area.

To lay off angles of 60° and 30°.—Mark any number of inches, say 14, on an indefinite line. Place the blade against one extremity of this distance, and the 7 in. mark of the tongue at the other. The tongue then forms an angle of 60° with the indefinite line, and the blade an angle of 30°.

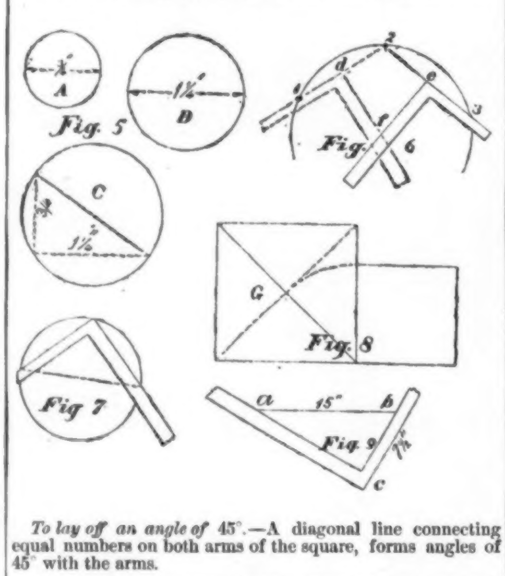


Fig. 5 Fig. 6 Fig. 7 Fig. 8 Fig. 9

To lay off an angle of 45°.—A diagonal line connecting equal numbers on both arms of the square, forms angles of 45° with the arms.

The hypotenuse and one side of a right-angled triangle being given, to find the other; or, two sides being given to find the hypotenuse.—Find in a manner similar to the rule for obtaining the length of a brace. For example, let the hypotenuse be 5 ft. and one side 3 ft., to find the other. Dividing these dimensions by three: we have 12 in. for the side and 20 in. for the hypotenuse. Mark off the 20 in. on the edge of a board or a straight line, as in Fig. 9. Lay the square with the 12 in. mark at *b*, and move the blade till it touches the other 20 in. mark at *a*. From *a* to *c* is found to be 16 in., which multiplied by 3 gives the hypotenuse.

To lay off an octagon in a square.—Fig. 10. Draw the diagonals *e* and *f*. Mark off the distance from the corner to the center *g*, on all the sides, measuring from the corners. The resulting marks give the corners of the octagon.

Fig. 13. Another method is to measure off the side of the square on its diagonal *k*. Square from a side to the point thus found on the diagonal, and *no* is the distance to be gauged from each corner, to mark the corners of the octagon.

To lay off an octagon on a given side.—Fig. 11. Prolong the given side *ab*, and lay off an angle of 45° at both *a* and *b*. The lines 1, 2, are squared up from the given side, also lines 3 and 4. By applying the square to the other lines we get the remaining sides.

To make a square stick octagonal.—Fig. 15. Lay the square or a two foot rule diagonally across the stick so as to measure two feet on it, letting the corners on the same side of the blade or rule touch the edges of the stick. Make marks at the 7 in. and the 17 in. marks. Measure thus at each end of the stick. Lines struck through these points show what is to come off to make it octagonal.

To find the side of an octagon when the side of the square is given.—Multiply the side of the square by 5 and divide by 12. The quotient is the side of the inscribed octagon.

When the side of the octagon is given, to find the square width. Suppose the side of the octagon is to be 16 ft.; take half this or 96 in. for the square, 16 in. on both tongue and blade taken 6 times, giving 11 ft. 3¾ in., which, being doubled and added to the side of the octagon, gives the square width.

Given the square width, to find the diagonal.—Fig. 15. Take half the square width, and half the side on the square, or proportional parts, double what is found from these, and the results is the diagonal.

To find the bevels and width of sides and ends of a square hopper.—Fig. 16. The large square represents the upper edges of the hopper and the small one the lower edges, or base. The width of the sides and ends is found in this way: Take the run *ab* on the tongue and the perpendicular hight *ad* on the blade. It is thus found in the same manner as the length of a brace. To find the cut for a butt joint, take width of side on blade and half the length of the base on tongue; the latter gives the cut. For a mitre joint take width of side on blade and perpendicular height on tongue; the latter gives the cut.

For the cut across the sides of the boards, take the run *ab* on the tongue and the width of side on blade; the tongue gives the cut. The inside corners of the sides and ends are longer than the outside, so if a hopper is to be of a certain size, the lengths of ends and sides are to be measured on the inside edge of each piece and the bevels struck across the edges to these marks. This is only in case of butt joints. Of course if the hopper is to be square, the thickness of the sides must be taken from the ends.

If the top and bottom edges are to be horizontal, the bevel is thus found: Take the perpendicular height of hopper on the blade and the run on the tongue, the latter gives both cuts. A hopper can be made by the above method by getting the outside dimensions at top and bottom, and the perpendicular height.

In large hoppers pieces are put down along the corners to strengthen them. The length, and the bevel to fit the corner are thus found: Suppose the top of hopper is 8 ft. and the bottom 18 in. square. Find the diagonals of each, subtract the one from the other, and half the remainder is the run for the corner piece. From the length of this run, *l*, and the rise, *ab*, we find the length of the corner piece. To find the bevel or backing, take on the blade the length of the corner piece and on the tongue the rise; the latter gives the bevel. Another method is to draw the line, *l*, to represent the seat of the corner piece, set off square with this the line, *m*, of the same length as the run, *ab*. Then draw *no*, which is the length of the corner piece. To find the backing, draw a line, *p*, anywhere across *l*, at right angles therewith, and at its intersection with line, *l*, strike a circle tangent to *no*. From

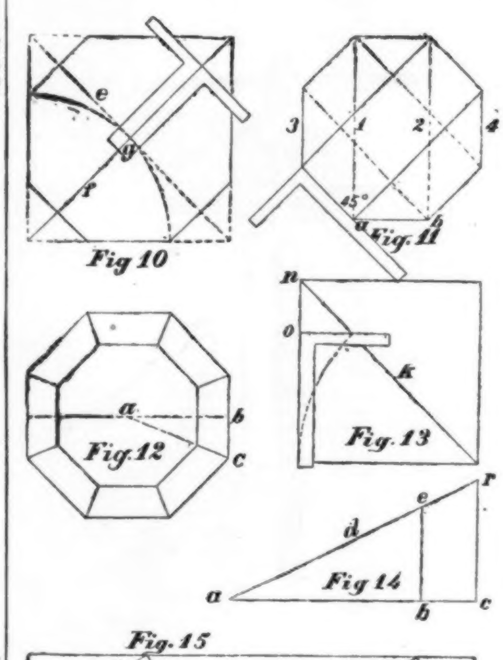
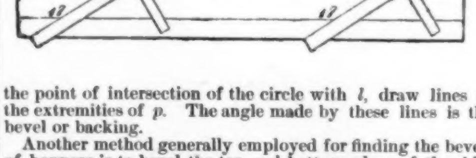


Fig 10 Fig. 11 Fig. 12 Fig. 13 Fig 14

Fig. 15



the point of intersection of the circle with *l*, draw lines to the extremities of *p*. The angle made by these lines is the bevel or backing.

Another method generally employed for finding the bevels of hoppers is to bevel the top and bottom edges of the sides and ends to the angle they are to stand at, then to lay a bevel set to a mitre, or angle of 45°, on the beveled edge, and that will lay off a mitre joint, while a try-square will lay off a butt joint. An angle of 45° will mitre only those boxes with sides which are vertical and square with each other.

When the sides and ends of a rectangular box or hopper are of the same width, that is, when sides and ends slope at equal angles, the bevels, either butt or mitre, are found as for square hoppers.

When a hopper has the sides and ends of different widths, that is, when sides and ends stand at different angles, both having the same rise, find the cuts for each from its respective rise, run and width.

Fig. 17. To bisect the angles *a* and *b* simultaneously with the square. Draw the centre line, *c*, place the corner of the square on this line, and move blade and tongue to the angles; then draw the bisecting lines. This method is possible only when lines *d* and *f* are parallel.

Roofing.—Fig. 18. A hip roof with two corners out of square is given as an example, the dimensions of which are: width 15 ft., rise of roof 5 ft., length 30 ft. on the shorter side, 33 ft. on the longer. The timbers *ab*, *cb*, *eg*, *eg*, are the hip rafters; JJ the jack rafters. The seats of each hip rafter should form a square, so that each pair of jack rafters, JJ, for instance, may be cut of equal length.

Lengths and Bevels of Hip Rafters.—We will first consider those on the square end of the roof. In order to find their length, it is first necessary to obtain their run, which is found as follows: Take half the width of building on both blade and tongue, whence is obtained the length of seat from *g* to *e*, at the intersection of the dotted lines. By similar use of the square, this length, with the rise of roof, gives the length of the hip-rafter. The lengths of all the rafters should be measured along the middle, as the dotted lines show. This

is the full length; half the thickness of the ridge-pole is to be taken off, measured square back from the bevel.

The bevel of the upper end of a hip-rafter is called the down bevel. It is always square with the lower end bevel, hence these bevels are found by the parts taken on the square to find the lengths of the hip-rafters. Another method is to take 17 inches on the blade and the number of inches of rise to the foot, that is, the rise in inches divided by half the width of roof in feet—on the tongue. The tongue gives the down bevel, the blade the lower end bevel. The reason for the foregoing is that when the hip-rafters are square with each other, the seat of the hip is the diagonal of a square whose side is half the width of building. The diagonal of a square with a 12 in. side is 17 in. nearly. So if the rise of roof in 1 ft. is 6 in., the rise of hip-rafter will be that only in 17 in. The directions here given assume that the hip-rafter abuts the ridge-pole at right angles, but as the ground plan of the roof shows that they meet at an acute angle, another bevel must also be considered, called the side bevel of the hip-rafters. Were there no slope to the roof, the bevel where they meet the ridge pole would be an angle of 45°, as the hips would be square with each other. When a pitch or slope is given, the hips depart from the right angle and therefore the side bevels are always less than 45°. Take the length of hip on the blade, and its run on the tongue; the blade gives the cut.

Backing of the hip-rafters. The backs of the hip-rafters must be beveled to lie even with the planes of the roof. This bevel must slope from the middle toward either side. It is found by taking the length of hip on blade, and the rise of the roof on tongue. The latter gives the bevel.

To find the lengths of the jack-rafters: Suppose there are to be four between the corner and the first common rafter; then there are five spaces, which, by dividing 7 ft. 6 in. by 5, are 1 ft. 6 in. from centre to centre of jacks. The rise of roof, also divided by 5, gives 1 ft. rise for the shortest rafter. The run is 1 ft. 6 in.: as both rise and run are given, the length down and lower bevels are found therefrom. The next jack has double the rise, run and length of the first; the following one three times, and the fourth four times. All the measurements are to proceed on or from the middle lines of the jacks.

The side bevel of all the jack-rafters is obtained by taking the length of a common rafter on the blade and its run on the tongue; the bevel on the blade gives the result.

Let us now consider the end of the building out of square. Fig. 17 illustrates the method of laying down the seats of the hips. To find the lengths of these hips, the lengths of the seats must be got by taking half the width of building on blade, and the distance from the end of the dotted line crossing the roof, to the corner on the tongue. The length of the seat so obtained taken on the square, with the rise of the roof, gives the length of the respective hip-rafter.

The down and lower end bevels are found as in the previous hip-rafters. To obtain each side bevel, add the distance from the dotted line to the corner and the gain of the hip-rafter; take the sum on the blade, and half the width of building on the tongue; the latter gives the cut.

The lengths, etc., of the jack-rafters on the side, are determined as at the square end of the roof; the side bevel being found by taking the length of a common rafter on the blade, and the distance from the dotted line to corner on the tongue. The latter showing the bevel.

The lengths of jack-rafters on the end. Assuming there are to be four jacks between the corner and the centre included, half the length of the end of the roof must be divided by 6. One side of the roof being 3 ft. longer than the other, we place 3 ft. on tongue, and 15 ft., the width of building, on the blade, and thus obtain the distance from corner to corner on the end of the roof. Half this divided by 5 gives the distance of the jacks apart. The distance from where the middle lines of the hips meet to the middle point of the end of the roof is also to be divided by 5, the quotient giving the run of the shortest rafter. The rise is the same as for the jacks on the square end.

These rules give the full length of rafters, so that when hips come against a ridge-pole or jacks against a hip, half the thickness of pole or hip, squared back from their down bevels, must be taken off.

Side bevels of these jacks are obtained by adding the distance from the dotted line to the corner to the gain of a common rafter in running that distance; take this on the blade, and half the width of building on the tongue. The blade gives the bevel.

Octagonal and Hexagonal Roofs.—Fig. 19 represents an octagonal roof. In its construction, the suggestions on octagons, previously made, must be referred to. The length of hips is found as usual from rise and run, the run being half the diagonal of the octagon. Cut the first pair full length to butt against each other, the next pair are to be set up at right angles to these, and each is to be cut shorter than the first pair by half the thickness of first pair, measured square back from the down bevel. The third and fourth pairs are to be cut shorter than the first by half the diagonal of a square whose side is the thickness of the first rafters. If the thickness of the first pair is 2 in., then the third and fourth pairs are shortened by $1\frac{5}{12}$, as $2\frac{10}{12}$ is the diagonal of a square whose side is 2.

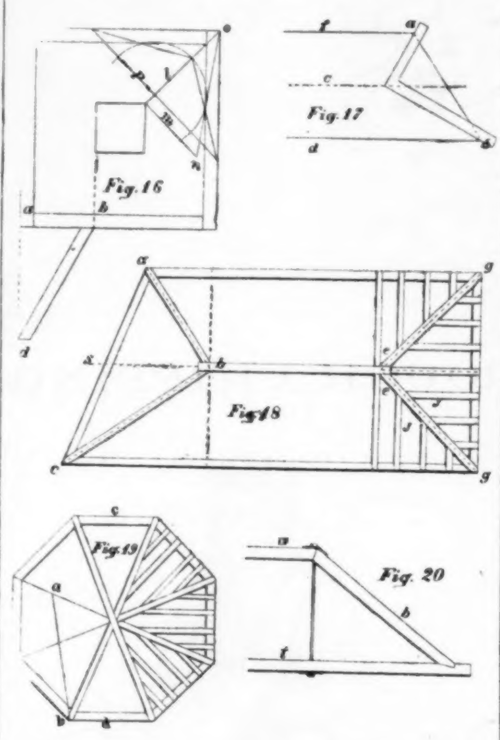
The first and second pairs have no side bevels; the side bevels of the third and fourth run back on both sides from the middle of the rafter. Find this bevel by taking the original length of rafter on the blade and its run on the tongue, when the blade shows the cut. The backing of the hips obtain by taking $\frac{5}{12}$ of the rise on the tongue, and the length of hip on blade: the latter giving the cut. For the side of an octagon is $\frac{5}{12}$ its square width.

Half the square width is the run of the middle jack-rafter, from which and the rise we get its length. From the length deduct the same amount as from the third and fourth pairs of hips. If there are to be two jacks between the middle one and the corner, we divide the length of side into three parts, also the rise, whence are obtained as before the distance of rafters apart, and the rise of shortest jack. Divide half the square width of octagon by three to find the run of shortest jack. Just as the square is laid on to find the length of a jack, it gives the down and lower end bevels; while the side bevel is obtained by taking length of middle jack on blade and half one side of the octagon on the tongue; the blade giving the cut.

A Hexagonal Roof.—The side of a hexagon equals the radius of the circumscribing circle. The square width, or apothem, is determined from one side and a diagonal of the hexagon.

The first pair of hips are set up as in the octagonal roof. The second and third pairs have a side bevel. To find this, take half the side of the hexagon on the tongue and half the square width added to the gain of the hip-rafter in running that distance, on the blade. The tongue gives the cut. Strike the bevel across the rafter. Now, the second and third pairs are to be measured back shorter than the first pair, on their middle lines, just half the length of this bevel. The third pair has the bevel cut on both sides from the centre. The backing of the hips is found by taking $\frac{7}{12}$ the rise of roof on the tongue and the length of hip on blade; the latter gives the cut. The side of a hexagon is $\frac{7}{12}$ its square width, or apothem. The lengths and bevels of the jack rafters are found as in octagonal roofs.

Trusses.—Fig. 20. *a* is the straining beam, *b* the brace, *t* the tie beam. Generally the brace has about one third the length of tie beam for a run. From the rise and run find the length and lower end bevel of the brace. After marking the lower end bevel on the stick, add to it just what is cut out of the tie beam. The bevel of the upper end of the brace where it butts against the straining beam is found in the following manner. Take the length of the brace, or a proportional part, and mark it on the edge of a board; take half the rise of the brace on the tongue, lay it to one of these



marks on the board, and move the blade till it touches the other mark on board. A line drawn along the tongue gives the bevel for both brace and straining beam. The angle made between brace and straining beam is thus bisected. Lay off the measurements from the outside of the timbers. Put a bolt where shown, with a washer under the head to fit the angle of straining beam and brace.

(*To be continued.*)

HOW TO DO IT, AND HOW NOT TO DO IT.

In walking through a workshop the eye of the ordinary observer will almost invariably lead him to form a tolerably accurate estimate of the capabilities of at least a large proportion of the workmen; and especially is this the case in a large shop, where the men can scarcely be so carefully selected as in small establishments, when their numbers are comparatively limited. There is something in the attitude, the interest taken in his work, the energy or delicacy, as the case may be, with which the expert workman handles his tools, which points him out as plainly as the awkwardness, indifference, or abstraction indicates his opposite; and what that something is, our artist has delineated far more plainly than words can express. Take, for example, the figure represented in "How to Do It" in the act of rough chipping, and it is observable at a glance that his mind as well as his muscle are concentrated upon his work. We are very apt to cast a pleasant glamour upon the past; and this it is which causes each successive generation to look back, perhaps with regret, to the good old times; and to those who highly value mechanical skill, the days of the hammer and chisel were good old times indeed. The workman of the special machine workshop of these days would be altogether surprised to see the large amount of good and accurate work which expert old mechanics can perform with the hammer, chisel, and file. There are, indeed, workmen still extant who would have no hesitation in undertaking to equal in quality and surpass in quantity, upon some kinds of work, the capabilities of the ordinary vise hand even with the assistance of a modern planer and shaper. Among this class of work the fitting-in of brasses into ordinary pillow blocks may be instanced. And although, as we have said, the hand workman of the good old times is not altogether extinct, he is not often found in special machine shops, but may be looked for in repair shops, where he commands nearly one third more than the average machinist's wages.

In the illustration under the heading of "How Not to Do It," our artist has represented not only errors in the method of manipulation, but also the want of interest in the work which is at times met with in large shops among the operatives; while in "How to Do It," he has shown the proper attitude for the workman performing the several operations, and has given him, in each, the look of a zealous and painstaking artisan.

The chipping hammer is not by any means the rude instrument which it appears to the uninitiated; and there are as many styles of using it as there are in the use of the pen. For heavy duty, it should be held near the end of the handle. The arm should swing freely, the hand never traveling further backwards than a line vertical to the operator's shoulder. The movement should be obtained partly from the elbow, partly from the shoulder, partly from the body itself, and (in a minor degree) from the wrist. If then we turn to the figure "Rough Chipping," in "How Not to Do It," we perceive that, with the hammer held as there shown, these movements would be difficult, and would cause a constrained action of the body and arm. The chisel should be held close to its head, gripped tight, and pressed firmly against its cut.

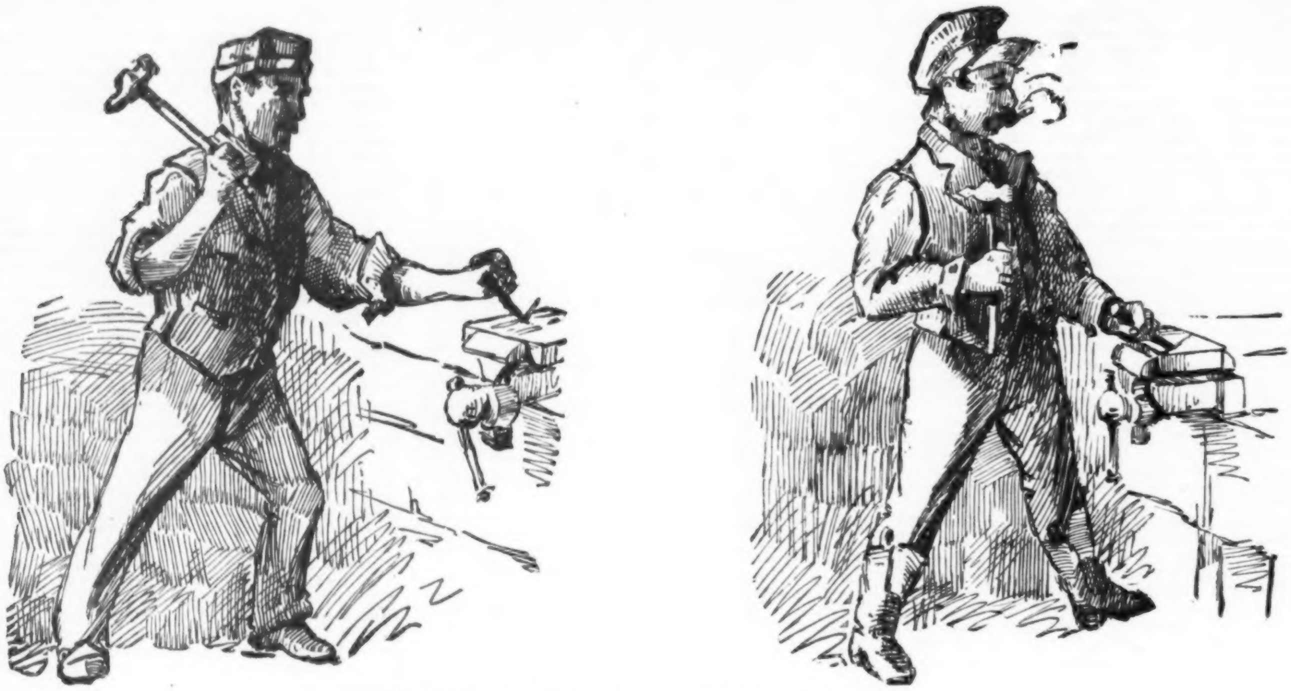
For fine chipping—that is to say, for the finishing cut—the chisel is held in the same manner, the hammer is grasped nearer to the middle of the handle, and the blows are comparatively light. Under such circumstances, the cut may be so smoothly taken that the finger applied over a length of, say, two inches, without the assistance of the eye, will fail to detect if the work has been chipped or filed. Both these operations require strict attention; and though apparently rude, they are actually delicate if skillfully performed.

In contrasting the two illustrations of rough filing, the practised eye would readily detect the improper manipulation, irrespective of the want of attention, shown in the one figure. The distance of the operator from his work would alone expose his unskillfulness. To properly use a rough file, it should be held so that the file handle presses against the palm of the hand, and hence so that the strain due to pushing the file will be in a line with the length of the arm from the hand to the elbow. The operator should stand well off from the vise, and must drive the file by a motion of the body almost as great as that of the arms. In this way, the weight of the body will be placed upon the file to such an extent that the heel of the operator's forward foot will lift from the floor, as shown in our illustration, the fulcrum for the pushing duty being the rear foot. During the return stroke of the file, the forward or left foot comes into play as a fulcrum, by which the operator's body recovers its former position; and it also enables the arms to relieve the file of pressure during its back stroke. The motion of the file during this latter stroke should be much quicker than during the forward motion. The file is a wonderful tool in skillful hands, capable of producing work more truly smooth and accurate than any other known cutting tool, the lathe tool not excepted. Its use, indeed, in the finishing processes is mainly to correct the inaccuracies which are inherent to work produced by other cutting tools, especially upon plane surfaces; and it is an inexorable fact that we have at this day no machine or tool capable of producing flat metal surfaces, as small as even as six inches square, so true that a judicious application of the file will not at least double the contacting area of two such pieces placed together.

Draw filing is a method of using the file which answers two purposes: the first to leave the file marks in the most desirable direction, and the second to touch only such parts of the work as require operating upon to secure truth and accuracy of dimensions. Having rough and smooth crossfiled the work down to such a size that the drawfiling will entirely erase the crossfile marks (for filing in the position shown under the heading of rough filing is called crossfiling, whether the file be a rough, second cut, or smooth file), the operator tests his work to discover the protruding spots or places. He then casts his eye along the length of the file, holding the latter edgeways to the eye, first to ascertain the curve or sweep of the face of the file, and secondly, to select a part of the file where that curve is the greatest and most regular. Then turning the file over, he brings the selected part of the file to bear upon the protruding part of the work, and uses the file as shown in our illustration, watching intently every mark made by the file teeth, so as to insure that the cutting duty is being performed exactly in the required spot, and that the surrounding surface is not being operated upon. If the surface of the work has been draw-filed all over, and it becomes difficult to distinguish the file marks being made, he gives the file a slight lateral movement (first to one side and then to the other) as well as a reciprocating one, so that the new file marks distinguish themselves by slightly crossing the old ones. It is in drawfiling that the utmost skill is to be shown; and here we may caution the operator against an error that he may be apt to fall into. This error is in taking long strokes in drawfiling; because in such case the filings are apt to clog in the file teeth, producing what are technically termed "pins," or "cat teeth," that is, small pieces of iron which stick fast to the file and cut scratches in the work, entailing a large amount of extra work to file such scratches out. It is obvious that the brains must not be wool-gathering when drawfiling is under operation; for good judgment, strict attention, careful manipulation, and perfect confidence must be combined to produce good work. An error in selecting the part of the file to be used, or an error in applying that exact spot to the requisite place in the work, will produce a hollow spot in the work, which, if the latter is down to its proper size, cannot be remedied· while want of judgment as to the quantity of metal requiring to be removed will cause either a badly finished job or else consume more time in testing the work than in filing it. *Apropos* of this latter fact, a well known master mechanic related to us the other day a piece of advice given by a skillful workman, A, to an artisan B, who, though a very industrious, painstaking man, was, from a lack of experience, somewhat the reverse. A had employed B to work for him by the piece; and giving him a locomotive guide bar to file up, he first told him to test the bar. Then, giving him a rough file, he said: "Now file off as much as you think is necessary, and don't be afraid of it; when you have done so, come and tell me." B set to work with a will: and in a quarter of an hour he came to A, saying that he had filed off what he considered ample. "Go back to your vise," said A, "and file off just as much more." "But—" said B. "There are no 'buts' in the case," said A; "do exactly as I tell you." B set doggedly to work, and obeyed orders; and on testing the job, it required a little more filing in the same places. "This," said our visiting master mechanic, "was a lesson I never forgot and have often remembered to my advantage." The moral here pointed is founded upon a fact which any one who watches the manipulation of vise hands (upon all but very small work) will speedily observe, namely, that, for lack of cultivating the judgment, it often takes more time to retry the work than it does to refile it. Fitting journal brasses, keys, dies, and sliding blocks, and filing true flat surfaces, may be instanced as classes of work in which this is liable to occur.

In seeking for the causes which often operate to make workmen indifferent to their work, we may mention that of paying for their time instead of the quality and quantity of their work.

We met, the other day, an expert workman who said that he had lost his ambition. "Where is my incentive?" said he. "I am only a mortal, just like other men. Energy among others is a means to an end. Health, fame, ease, and luxury are the prizes for which men strive. Show me the man who is energetic in a single cause in which one of these is not the aim, the incentive, and the reward, and answer me honestly how can I make an exercise of more than common energy or industry subservient towards giving me one of these prizes."



ROUGH CHIPPING.

PATTERN SAWING.

AUGER

ROUGH FILING.

TOOL

HOW TO DO IT AND HOW NOT TO DO IT:

FINE CHIPPING.

BORING.

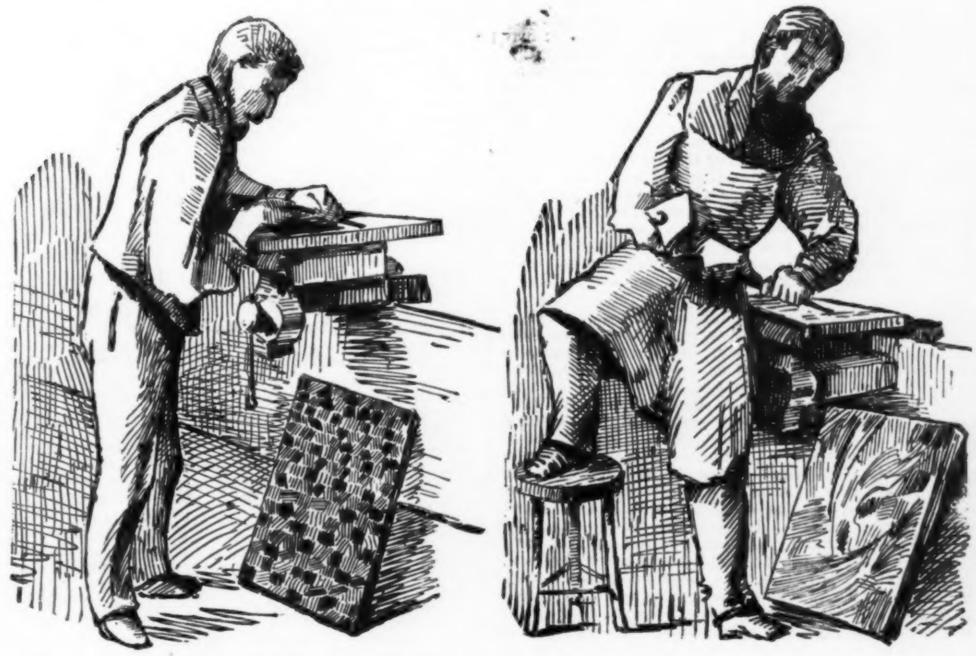


PLATE SCRAPING

GRINDING.

FINE FILING.

A SERIES OF LIFE SKETCHES IN PRACTICAL MECHANICS.

"You will never be out of work and always command respect," was the answer. He smiled, and holding a scraper in one hand and a file in the other, replied: "I never was out of work a day; I am too well known. I put forth my energy when I want work, and get it at once. Having got it, I work along easily and pleasantly; am always on the best of terms with my employer, get the best of wages, work ten hours a day, and jog discontentedly along, my ambition, energy, and extra ability rusting away for want of the incentive which all men require to call forth more than ordinary exertion. Now where is my remedy?" "Piecework," was the suggestion made in reply. "You have struck it," was the response. "When I worked on piecework, the work I did seemed mine; every job well done brought me more work; I engaged other men, and taught the boys all I knew; every scrap of information I gave to my men or boys brought me in money by increasing their skill; every extra dozen blows I struck were represented in my wages on Saturday night. I looked well ahead at my work, often preventing blunders from being committed; I was a hard-working, happy man, putting by something for old age. But where am I to get piecework now? One establishment has been working short time, another is doing little or nothing, and most of the others don't see the advantages of the piecework system, which can and has been carried to the greatest success, even in repair shops."

We have often suggested piecework, but the reply is that it cannot be adopted in a repair shop or on promiscuous work. Why not? An average job, we will say, even in a small shop, lasts a day; and how much trouble would it be to estimate the value and keep an account (in a small shop) of six jobs a week? Any job done in a shop a second time can be estimated upon for piecework. Sometimes people say: "We do not know what the job is worth." Of course they do not. If a man ties his arm in a sling, he must expect it to grow weak. Just the same with the judgment and perception. Men used to piecework can estimate how much there is in a job, down to an hour's work: but men who never give the subject an hour's thought, cannot. "When I'm too old to work at all," said our friend, "there will be no such thing as daywork, except for laborers."

Those who have never tried piecework can have no conception of its advantages.* They foresee difficulties and fail to perceive the remedies which always present themselves after the piecework system is introduced, yet, strange to say, it is a very rare circumstance for the piecework system to fail where properly introduced. Transient piecework may fail because the operative is tempted to slight his work; but if a proper impression is made, the workman knows that inferior manipulation will lose him his piecework, while good work at moderate price will increase it, so that in time he may employ others to work for him. As an evidence that piecework is an excellent remedy for "how not to do it," we may instance the fact that some of the best of work is now done by that system, as watchmaking, sewing machine manufacture, gun work, etc. No one will say that these are inferior, in point of fit and finish, to what they were before the introduction of piecework. A fair starting price for piecework is one-third less than the same work has been costing by the day, and there are but few expert workmen who will not accept work at this reduction.

Referring now to the illustrations representing tool grinding, we shall observe that the fault in "How not to do it" lays largely in the grindstone, which is shown unprovided with any water can or tool rest. As a result, if there is water in the trough of sufficient depth to touch the stone, the latter takes up too much water and throws it over the floor. When the grindstone is at rest for any length of time, that part of the stone which is in the water becomes softened, and then wears away more readily, causing the stone to become untrue, thus rendering it almost impossible to properly grind a tool. Tool grinding is an operation requiring care and some skillful manipulation. The stone, when in good order, should not only run true, but should be kept a little rounding across the face. It is too often the case that it is nobody's duty to true up and keep the grindstone in order; hence each one who uses it leaves the unpleasant task to his neighbor, while all declaim that the stone is not kept in proper order. There is no excuse for this, especially as there are no truing devices made, which, when fixed to the grindstone frame or trough, will automatically true up the stone in a few minutes.

In the illustration of boring our artist has shown the result of inattention. Nothing is more destructive to good work than holes bored out of true, for the holes are usually the determining points for the completion of the work. In tthe figures representing sawing, carelessness is shown in "How not to do it," the operator neglecting to place his work in a proper position. The result is that he is sawing at an angle, and with very little prospect of sawing correctly. The carelessness of workmen is very often attributed to negligence in the general supervision of their labor. A workshop is never too small to have a system. Want of system may be the cause of waste of both time and material, thus engendering constant worry and discontent. This is especially the case in shops where promiscuous work is done. In such establishments we may often find the floor covered with litter, heaps of cuttings under every lathe, machine, or bench. On the floor, perhaps, old and new material of all kinds will be thrown into a pile in almost inextricable confusion. The machinery will be found incrusted with oil and dirt, except it be in those parts worn bright by the hand of the operator in using. The cutting tools, bolts, plates, and other appliances which are to be used with these machines, lie carelessly thrown around, and often a new stratum of dirt seems to be fast closing over some of them. Overhead may perhaps be heard the harsh grating of a loose pulley. The belts have been thrown off others by some sensitive workman, who cannot bear the unpleasant noise they occasion. When so thrown off these belts dangle from the shafts, the driving shaft keeping a stretch on one side and wearing them at the point of contact. There is perhaps no one whose special duty it is to look after the tools to replace or repair them when necessary. Standard tools are often altered to suit odd jobs, and so on to the end of the chapter, with the result that, when a job comes in, more time is consumed in seeking and altering tools for it than in doing the work required.

Workmen are naturally largely influenced by their surroundings. Well-kept tools will always command the better usage. A clean shop generally contains proportionately more careful workmen, just the same as a well-managed one produces more skillful men. Shops are known wherein the method of taking the account of time had much to do with the quality of the workmen, for the time in which certain kinds of work had been done in past years was well known, and it was a point of pride, for a workman who wanted a raise of wages, or a boy who wished promotion, to be able to say "I did such and such work in so long a time." Even the character, as a workman, was often gauged among the others by the time he spent upon his work, the time made upon some particular sort of work being handed down as a kind of standard. In short, there is no better way to avoid "how not to do it" in the workshop than by practising "how to do it" in the every-day management of the shop.

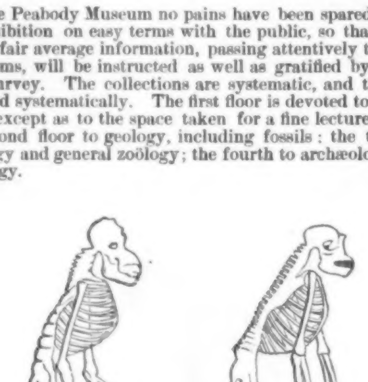
THE PEABODY MUSEUM, YALE COLLEGE, NEW HAVEN, CONN.

The original gift by the late George Peabody was $150,000; of this sum $20,000 is to be entirely reserved until it amounts to at least $100,000, when it may be used for other parts of the whole edifice. A sum of $30,000 is also reserved to provide something toward an income for the maintenance and care of the Museum.

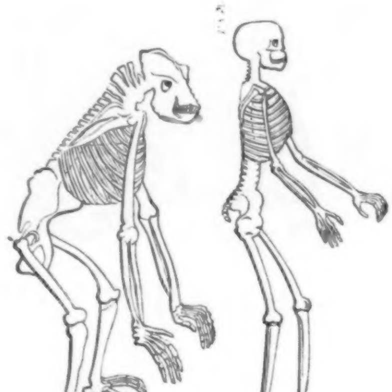
After $20,000 and $30,000 had thus been set aside from the fund, $100,000 remained for the erection of the present building, and that sum was invested with such judicious skill that its total was finally raised, in the course of about ten years, to $176,000. The executive officers of the board to whom this trust was confided, are Profs. J. D. Dana, G. J. Brush and O. C. Marsh.

The Peabody Museum is of brick, with stone trimmings. It is practically of five stories, since both the basement and the attic are high and well lighted. The present structure consists of a main building and a wing; the roofs are lofty and pinnacled. In the design the building is not severely simple, yet it is not overloaded with ornament; in this particular, both as to details and general outline, the happy mean is struck. The architect is Mr. J. C. Cady of New York.

In the Peabody Museum no pains have been spared to put the exhibition on easy terms with the public, so that a person of fair average information, passing attentively through the rooms, will be instructed as well as gratified by even a hasty survey. The collections are systematic, and they are arranged systematically. The first floor is devoted to mineralogy, except as to the space taken for a fine lecture-room; the second floor to geology, including fossils; the third to osteology and general zoölogy; the fourth to archæology and ethnology.



ORANG. CHIMPANZEE.



GORILLA. MAN.

Without intending any disrespect to the footprints, the precious stones, the mammoth, the six-horned dinoceras, or even the birds with teeth, the curiosity seeker may for the moment pass them by and begin with the third story, where are the specimens of zoölogy, the life of the present day. Of course the subsequent proceedings will be somewhat undignified if the start is made at the top of the ladder, but the human race should be always the first to claim our sympathies. Since the proper study of mankind is man, it is well to begin here with the case nearest the door, labelled "Primates." There they stand in a row, in just the condition that Sydney Smith wished for in hot weather—with all the flesh removed from their bones. And now—how shall I state it tenderly, without giving offence?—the Primates of science, unlike those of the Church, include, with man, the monkeys; and looking down the row of skeletons and skulls, it is not easy to say at a glance where man ends and ape begins. There are skulls with lofty foreheads that look like the dome of thought, but unfortunately they belonged to chimpanzees; while other skulls, with low crowns and scarcely any forehead, once held the brains of some Indian chief or South Sea Islander. In this display of anatomy woman holds the place of honor, the finest of the skeletons of the human race being that called, by the disrespectful attendants of the Museum, the "Chicago Girl." Her figure was tall and admirably proportioned, but the special interest which attaches to her skeleton is that she possessed an extra pair of ribs, or rather riblets, attached to the seventh cervical vertebra. Ordinary mortals are not thus provided with a spare rib; perhaps Adam was in his younger days. The "Chicago Girl" might have been an adept in dancing, for in both feet the bone on the inside of the elevation of the instep, which in ordinary skeletons is a single bone, with her is of two pieces, doubtless giving additional flexibility. Compared with this young lady, the bones of a Chinaman (21 years of age) standing alongside, show a feebler frame. From the well-known custom of the Chinese of carrying the corpses of their deceased countrymen back to the homes of their ancestors, skeletons of that race are among the most difficult to obtain; but the Museum is rich in Asiatic bones, and has one of the finest collections of Chinese and Japanese skulls in the world. It seems to be the general rule with the specimens throughout the Museum that each of them is rare, peculiar, or hard to match, and many of them are consequently of high value. Every known species of some of the rarer groups is here represented. Among them are the anthropoid apes, orangs, gorillas and chimpanzees old and young, and of each sex; and numerous brain casts, as well as skulls, that will afford food for thought not to the anatomist only, but also to the metaphysician. Other museums considered themselves enriched by a single skeleton or even a skull of a gorilla, and few are so fortunate; here there are half a dozen skeletons of that animal, and also many of its skulls; the other man-like apes are even more fully represented. But it is time to notice the systematic arrangement of the osteological specimens in this room; it is as follows:

Primates: including men, monkeys and lemurs.

Carnivora, including bears, hyenas, tigers, cats, dogs, etc.; also, the sea-otter, wolverine, walrus, seal, etc.

Ungulates: divided into Artiodactyls or even-toed animals, such as goats and sheep, deer, antelopes, bovines, camels, various swine, etc.; Perissodactyls or odd-toed animals, such as the tapir, rhinoceros, and a complete series of the equine group; Probiscidians and Hyracoidea, a case where extremes meet, as the one sub-division includes the elephant, and the other the hyrax or coney.

Rodents: such as rabbits, squirrels, beavers, and all kinds of rats and mice.

Cetaceans and sirenians: such as the whale, porpoise, dolphin, manatee, dugong.

Edentates: such as the armadillo, ai, sloth, ant-eater.

Marsupials and Monotremata: such as the opossum, kangaroo, duck bill (ornithorhynchus).

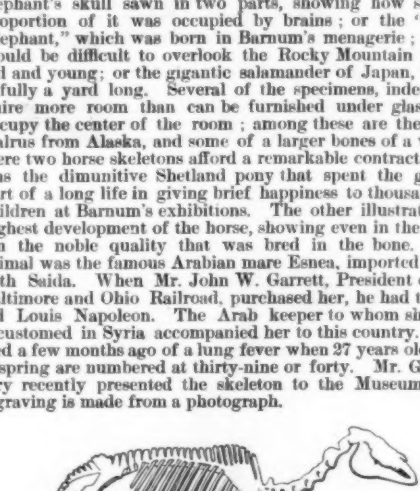
Birds: land, water and struthious; the last including the ostrich, emu, rhea, cassowary and apteryx.

Reptiles: crocodiles, lizards, snakes, turtles.

Batrachians: frogs, toads, salamanders.

Fishes—survivals of old forms, such as the gar-pike, amia, sturgeon; also the shark tribe and Teleosts or modern fishes.

Thus by a series of existing animals, none of the extinct races being here introduced, the student may see something of the relationships of structure all the way from fish to man. All quarters of the earth have contributed to fill this series, and neither pains nor cost have been stinted to obtain the rarer types that complete the intervals. These specimens are peculiarly valuable to investigators who are tracing the order of descent of animal life. With this view, the case of primates contains a series of pre-natal skeletons of the human species, which have already occupied a popular designation of the museum as the "Infant Class;" and in general the younger forms of animals have been liberally provided, as these throw great light on the theory of descent from ancient types. The series of the existing horse family is fully presented; this is also true of the rhinoceros and of other groups. Of course such complete results throughout the range of Natural History have only been obtained by sharp and prompt competition with foreign museums, as to purchase; and also, by employing collectors in the ends of the earth and on every continent. There are so many curiosities worthy of separate mention that they cannot be even referred to here; but the visitor is not likely to miss the elephant's tusks cut so as to show where bullets had been imbedded and afterward overgrown with ivory; a large elephant's skull sawn in two parts, showing how small a proportion of it was occupied by brains; or the "Baby Elephant," which was born in Barnum's menagerie; and it would be difficult to overlook the Rocky Mountain goats, old and young; or the gigantic salamander of Japan, which is fully a yard long. Several of the specimens, indeed, require more room than can be furnished under glass, and occupy the center of the room; among these are the great walrus from Alaska, and some of a larger bones of a whale. Here two horse skeletons afford a remarkable contract. One was the dimunitive Shetland pony that spent the greater part of a long life in giving brief happiness to thousands of children at Barnum's exhibitions. The other illustrates the highest development of the horse, showing even in the skeleton the noble quality that was bred in the bone. This animal was the famous Arabian mare Esnea, imported along with Saida. When Mr. John W. Garrett, President of the Baltimore and Ohio Railroad, purchased her, he had to outbid Louis Napoleon. The Arab keeper to whom she was accustomed in Syria accompanied her to this country. She died a few months ago of a lung fever when 27 years old; her offspring are numbered at thirty-nine or forty. Mr. Garrett very recently presented the skeleton to the Museum; the engraving is made from a photograph.



ARABIAN RACE-HORSE "ETNEA."

The whole osteological collection is three or four times larger than the portion displayed. It was in great part made by Prof. Marsh, and largely at his own expense, with a special view toward facilitating the comparison and study of fossil remains. Mr. George Bird Grinnell, who was with Prof. Marsh on some of his expeditions, and with Gen. Custer on the first entry of the Black Hills region, has been appointed by Yale College as Prof. Marsh's assistant in osteology. Mr. Grinnell has rendered important services in arranging this collection, and it will remain under his immediate care.

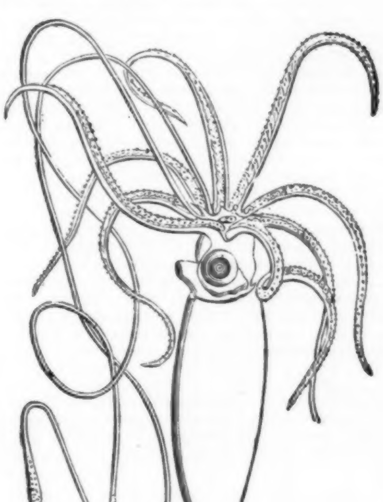
FISHES AND BIRDS.

The remainder of this room, as well as the rest of the third floor, is devoted to zoology. Of this department Prof. A.

E. Verrill is curator. There is here a systematic collection of vertebrate animals, including fishes, presented in their external forms; some stuffed, some in alcohol. Here, as elsewhere in the building, the specimens are among the best or rarest of their kind, and those which illustrate the relations between separate groups of animals are especially to be found. Such, for instance, are the dipnoi or double-breathers among fishes, having both lungs and gill. These are represented by the lepidosiren and the ceratodus, the latter, as far as the teeth are concerned, almost exactly similar to the ceratodus of the triassic epoch—a very distant one in geology. The fact that this animal has been found living in Australia, and that the changes in form of the teeth, if any, have not been important, is one of the most remarkable in modern discovery. The survival of its race through the long series of changes in the earth's crust since the trias, shows that whatever may have been the upheavals and subsidences of the earth in the great interval, no complete destruction of life throughout the globe has taken place. Even though the pre-glacial man should be discovered, the antiquity of the human race must be regarded as that of a day-fly compared with the ceratodus. On the top of the cases on this side of the room other strange fishes are mounted; these are principally of the shark tribe.

CREATURES WANTING IN BACK-BONE.

The invertebrate life of the present day is also presented in the west room of this floor, in similar systematic arrangement. There is a good collection of insects, showing representative ones of each family, but with no attempt at exhibiting all the species. By such means the student is enabled to survey the whole field of entomology upon examining not more than a thousand insects—a bird's-eye view such as no bird has ever enjoyed. When a visitor from the prairies of the West begins to talk about grasshoppers, he is led up to view *Tropidacris dux* from Central America. This leader of the 'hoppers measures eight inches across the wings, and six and a half from tip of antenna to end of leg. The leaf-insects from India are admirable specimens of their kind; they justify the forecastle yarn about the leaves dropping off the trees on one of the South Sea Islands and assembling in a swarm to share with shipwrecked sailors their breakfast on shore. Something ought to be said here concerning the ingenious boxes that contain the insects, the excellent arrangement of labels, and the like; but in all such matters this museum is beyond reproach. In another set of cases the crustaceans are displayed to the utmost advantage. Each individual crab seems ready to walk the waters like a thing of life. Prof. S. I. Smith, who is an authority on the natural history of the crabs, has devised methods for showing off his pets with all their natural grace; they are evidently as ready as ring politicians to seize plunder with claws that will not relax till they are broken, or to back down on principle at a moment's notice. The pincher claw of what was probably the "boss" lobster is thirteen inches long by seven broad, and as formidably armed as an old-fashioned rat-trap. Consider what would have been the feelings of a bather if that pincher had closed on a tender extremity—say upon a great toe. Other strange creatures of the sea are in adjoining cases: star-fish bigger than Kentucky flapjacks, and probably as tough; anemones and hydroids preserved in glycerine, and expanded in nearly all their glory of wreath and color; polypes and jelly-fishes that have resigned life suddenly when dropped into picric acid; barnacles much larger than a goose egg, and of a shape to encourage the ancient belief that wild fowl might be hatched therefrom. Another of the old traditions of the sea, the story of the Kraken, which could throw out his long slimy arms around a vessel and drag it down beneath the waves, turns out to be true, since this very attempt was made upon a boat off the Newfoundland coast by an immense cuttle-fish; and here in the Peabody Museum are the arms of such a sea-monster, preserved in alcohol, and evidently not wanting in length or strength for such performance.



THE GIGANTIC CUTTLE-FISH.

As representing the sea life of the New England coast the collection is quite complete, having rare and in many instances type specimens obtained in dredging expeditions by Profs. Verrill and S. I. Smith and the U. S. Fish Commission. Especially is the selection of fine specimens apparent in the corals and sponges, many being "uniques," that is, the only ones of their kind ever discovered. Both coasts of this continent are here well represented, and the magnificent corals of the Wilkes Exploring Expedition contribute largely to the show. Prof. James D. Dana (the geologist), accompanied the expedition, collected many of the finest of these specimens, and wrote a standard work on that branch of zoölogy. Even the casual visitor cannot pass some of these great corals without a feeling of admiration for perfect development of form or color; such for instance as a meandrina (brain coral), exactly dome-shaped, and more than four feet in circumference, or the gorgonia corals, having the form of miniature forest trees and rich in the brightest tints of autumn foliage—varied combinations of red and yellow of every possible shade. To several of these an individual history is attached, well worth the telling, but space presses. When a visitor talks of the minute "coral insect" to Prof. Verrill, he is shown a gigantic one—a single animal eighteen and a half inches long and seven and a half wide—and reminded that the term "insect" is a sad misnomer. The beautiful "glass sponges" are here in great variety, cornucopias of woven glass with lace fringes and lid, and showing the fibres at the base, by which they were once secured to the sea-bottom. There is here an elegant "Neptune's cup," which is 6¼ feet in circumference and 2½ high—a goblet worthy of the Sea-God. Beside the general collection of marine animals, there are three separate collections which are special in their character. These are, one from the New England coast (already alluded to); one from the Pacific coast, complete from Behring's to Magellan's Straits, and one equally complete from the coasts of our Southern States. In general it should be said that the completeness of the collections from the coasts of the United States is one of the most satisfactory features of this museum.

Each of the floors has its own proper laboratory and working rooms, well appointed, and in constant use by the professors in the department to which the floor is appropriated.

From the creatures that are now existing on the globe to those that perished in by-gone geological epochs thousands of centuries ago, is in this museum only a step to a lower story. The "vertebrate fossils" have a room to themselves, and even when only the choicest of them are picked from Prof. Marsh's abundant collections, they will more than fill the space assigned. Already in the cases intended for mastodons and fossil elephants, the great bones of the Otisville mastodon have crowded out all else. The bones produce the impression of great size, and spectators view them with apparent awe. The enormous teeth and jaws are complete; the skull is 3¾ feet long; the great arch of the pelvis is 5 feet across, and still bears the mark—now historic—where an inquisitive countryman poked it with his cane, just to find out how hard the bones were. It is the best preserved mastodon yet discovered.

Ten years ago there was scarcely a specimen of existing or fossil vertebrates among the collections of Yale College—unless indeed some of her professors were themselves unconsciously shelved. To-day these collections, especially of the rarer forms, have no equal in the world. I see no other way to present the facts than to give full credit to Prof. O. C. Marsh, and state some of his discoveries in as few words as possible. His fossil horses—or rather animals of the horse family—from the 4½ toed quadruped no bigger than a fox to fully developed and single-hoofed steeds not to be distinguished from those of the present day—illustrate the successive strata of the rocks from the lowest eocene epoch upward, by no less than 40 species, all different, yet all indicative of the gradual development of the modern horse. Another series of animals forming the connecting links between reptiles and birds has been very largely illustrated by Prof. Marsh's labors. All the steps of this most important chain of development have not yet been ascertained, but the contributions to it from the fossils of the West that are in the Peabody Museum make the few other discoveries in this field of research comparatively insignificant. Of birds that existed in the cretaceous epoch, there are, for instance, only two known (from fragments) in Europe; here there are the remains of not less than twenty distinct species, there being of each an average of about a dozen specimens. These include the wonderful birds with teeth, apppropriately named the *Odontornithes*, which are now divided into two orders according as they have their teeth set in grooves or in distinct sockets. Of some of these the skeletons are almost complete as to individual birds; and Prof. Marsh is at present engaged upon a large and elaborate monograph on this subject, describing and illustrating the new forms by copious engraved drawings; one of the rooms on the second floor is at present occupied by the skilled assistants and the draughtsman engaged upon this important memoir. Another of the alliances between birds and reptiles, of which the birds with teeth supply such remarkable examples, is suggested by the pterodactyls, or flying lizards of the same cretaceous beds in Kansas. Prof. Marsh was the first to find any pterodactyls in America; these are of enormous size, the spread of their wings being from ten to twenty-five feet. The singular feature about these reptiles from American rocks is that they had no teeth, and hence in this respect they resemble the modern birds. The remains of other reptiles have been discovered in the cretaceous beds of the West, and the specimens here brought together include the bones of several thousand individuals. From these abundant remains Prof. Marsh has been able to determine many doubtful points, such for instance as that the mosasaurs had hind limbs or paddles, and that they were covered, at least in part, with hard, bony scales. The mosasaurs were sea-serpents, from ten to sixty feet in length. Besides these there are here also the remains of gigantic crocodiles, lizards, turtles, and snakes, any one group of which would make the reputation of an ordinary museum. Of the enormous reptiles of geology, none yet known surpassed in size one which Prof. Marsh has recently described. Its remains were found in the cretaceous beds of Colorado; it is named *Titanosaurus montanus;* it was herbivorous, and attained a length of fifty to sixty feet. Believers in a vegetarian diet should take note of these facts, as that saurian was the largest land animal known to have existed on this planet. The reptile will also supply a bone to pick, that will puzzle people who have assumed that animal life in this hemisphere has been in general represented by smaller forms than the corresponding ones of other continents. If the question of size should ever be raised as to the mammals of the West, the Peabody Museum can show the remains of more than 100 distinct individuals of the dinoceras kind—a new order of mammals from the eocene of the Rocky Mountains, nearly equal to the elephant in point of size, and armed with four to six horns, as well as formidable tusks; or point to the brontotherium of the miocene rocks—a creature as large as the dinoceras, and also armed with horns. The oldest known member of the rhinoceros family, perhaps its progenitor, has also been discovered by Prof. Marsh in the upper eocene of Utah. From the lower beds of the same formation in Wyoming Territory came the tillodonts, perhaps the strangest of all eocene mammals, as they seem to combine characteristics of the carnivora, rodents, and ungulates. There, also, the same discoverer first found the North American monkeys, which are allied on the one side to the lemurs of the Eastern Hemisphere, and on the other to the monkeys of South America.

The list of these discoveries could be greatly extended, but even a mere catalogue of the novelties would be much too long for this letter, since it would include more than 300 animals new to science, about 200 of which Prof. Marsh has already described in technical publications. In general it may be stated that a very large number and variety of animal forms are here collected, which enable men of science to trace the connection between the strange creatures of early geological eras and the animals that are living to-day. The changes of form which constitute the life history of the earth are displayed by these fossils in the order in which they actually took place. Until these specimens were found and their characters determined, the story of the development of our existing animals could only have been surmised; no Old World fossil remains supplied the deficiencies of the

THE EXTINCT IRISH ELK.

series, and indeed the evidence was far from conclusive that the change from one form of animal life to another took place in Europe. At all events, these fossils of the West demonstrate beyond a reasonable doubt, concerning certain groups, as to when, where, and how the change did actually occur. In that respect this collection of "fossil vertebrates" is absolutely unrivalled. It also contains, however, a considerable number of European fossils that are of the rarer kinds, or have some specialty that makes them valuable, such as the famous Eichstadt pterodactyl that Prof. Marsh secured by a cable dispatch, and by paying a sum of money which (as Prof. Agassiz himself said to me) had the effect of raising the price of fossils throughout Europe. In the lithographic stone that holds the pterodactyl's remains, there appears the impression of the stretched membranes that served the animal as wings, like those of the bat. But there is not room here to go into these interesting details. The arrangement of the cases is somewhat similar to that of the osteological display; their fossil contents, when the specimens are all placed, will be somewhat as follows: Primates (chiefly monkeys and lemurs); Mastodon, Mammoth; Dinocerata, Brontotheridæ; Perissodactyls (horse and rhinoceros families, etc.); Artiodactyls (camel, pig, deer families, etc.); Carnivora; Tillodontia; Bats, Rodents, Marsupials, etc.; Turtles; Dinosaurs; Mosasaurs; Plesiosaurs; Ichthyosaurs; Crocodiles, Lizards, etc.; Fossil Fishes; Pterodactyls and Pteranodons; Cretaceous Birds (*Hesperornis*, *Ichthyornis*, etc.); Tertiary and Post-tertiary Birds. The last-mentioned division may include extinct birds of the present epoch, which are here represented by about a dozen skeletons of the dinornis or moa (being a much more complete series than is owned by any other museum, with the possible exceptions of that in the British Museum and one in New Zealand); several skeletons of the great auk, and various remains of the dodo. The perfect skeleton of the gigantic Irish elk, as the animal is extinct, will probably find place in this room; but certainly none of the cases can contain this fine specimen, since the spread of its antlers is 13 feet 2 inches.

INVERTEBRATES AND FOSSIL FOOT-PRINTS.

In the west rooms of this second story the system of arrangement is that of the earth's strata, and the standard text-book, Dana's Manual of Geology, is essentially followed. The fossils of this room are mainly the invertebrates and plants; many of them are type fossils, selected as the finest, and fixed permanently in scientific literature, by being drawn and figured. A large number of the originals, which are illustrated in Dana's Geology, may be found in these cases. By simply walking around the room and looking at the specimens successively, the student or even the ordinary visitor would get an idea of the order of the layers in the crust of the earth, since each case contains the representative fossils of an epoch, and the cases are arranged and labeled as follows: Silurian, Devonian, Carboniferous, Permian, Trias, Jurassic, Cretaceous (Western, etc.), Cretaceous (Eng. chalk, etc.), Eocene, Miocene, Pliocene, Post-pliocene, Recent. A large case is devoted to Fossil Fishes; another to extinct Insects, Crustacea, Brachiopods, and Cephalopods; another to Trilobites, Corals, Crinoids, and Sponges. In each case there are subdivisions, which serve to make the systematized character of the collection more impressive. This room has been further made of service by the addition of an extensive gallery, which will contain a large collection of fossil plants, and also several great saurian monsters—veritable sea-serpents—which are too long to be accommodated in the cases of the south room. While on the subject of palæontology, it may be as well to mention here that the collection of fossil foot-prints from the Connecticut Valley, which is stored and partly exhibited in the basement of the building, is by far the largest of its kind. These were originally supposed to be bird-tracks. They are all that is left to tell us of many thousands of animals which must have walked upon that beach ages ago. The rocks of the epoch in which they lived were not of a formation that was favorable for preserving their fossil bones, and it can hardly be said that any of the animals that made the tracks have been identified. But it is now known, or at all events generally admitted, that these very numerous and various foot-prints were made, not by birds mainly, but by reptiles, probably dinosaurs. The department of palæontology in the museum thus includes fossil vertebrates, invertebrates, plants, and foot-prints. Mr. Oscar Harger, who accompanied Prof. Marsh on two expeditions across the continent,

and has been his assistant in palæontology for several years, still occupies that post, and thus renders good service to science.

RARE MINERALS.

Most visitors, on entering the museum, go at once into the room on the first story, which contains the mineralogical collection. This is in charge of Prof. E. S. Dana, and is far advanced toward completeness of arrangement. Here, as in other rooms, the main feature is a classified, orderly display; this occupies twenty-five cases. Certain special objects and peculiar collections are shown in separate cases. Besides the minerals displayed, there are large numbers in the drawers and cupboards attached to the cases, and the arrangement of these is as complete as of those which are under glass. The general system may be described as being on a chemical basis, the first series of cases containing elementary substances, such as the metals; the next series, the compounds with sulphur, arsenic, etc.; then the minerals of which chlorine, fluorine, etc., form part; next the oxides; next, silicates; finally, phosphates, carbonates, etc. The number of choice and rare specimens is unusually great. I have seen many cabinets of minerals, but I do not recall having seen a large or systematic display that was so bright and attractive in all its parts. Small specimens, or those containing curious or costly crystals, are set near the glass of the cases and with a magnifying lens in front of each; this simple contrivance enables the visitor to examine such specimens at once without opening the cases. North America is not famous as a land of precious stones, but it is by no means barren of them, and in showy minerals it is not to be despised. The Labrador felspar is as beautiful in its prismatic colors or its aqua-marine blue as the more noted stones from European quarries, that, carved or shaped for ornamental use, made a feature of the foreign exhibits last year at Philadelphia. From Mexico there are strange opals, with a peculiar scintillation quite unlike the fire of the Hungarian gem. New Hampshire furnishes a beryl fifteen inches high and thirteen across; a more regular crystal of this sort is about twelve by ten inches. New York supplies a great crystal of calcite (from the Rossie lead mines, St. Lawrence County,—size in inches, sixteen by twelve by eight; and an almost equally large specimen of fluorite from Muscalonge Lake, Jefferson County.

As Prof. Olmsted, of Yale, first proclaimed the accepted theory of meteoric showers, it is meet that this museum should be well stocked with meteorites. Its collection is the second in importance in the country; Dr. C. U. Shepard's, at Amherst, ranking as the first, and Prof. J. Lawrence Smith's, at Louisville, as the third. One of the meteorites under Prof. Dana's care has a history that points a moral for New Yorkers. It had been deposited with the Lyceum of Natural History in New York, by Mr. George Gibbs, but by some inexplicable neglect was allowed to lie for years uncared for in City Hall Park. One day, when a fall election made it necessary to find work for unemployed voters, some Irishmen were ordered to bury this great black stone out of sight. They had dug a hole for the purpose, and the meteorite was just about to disappear for ever from human view when Mrs. Gibbs interposed, rescued it and sent it to Yale College, where it has ever since borne the name of the donor, being known as the Gibbs Meteorite. Its weight is 1,636 pounds. When the history of science in New York city is to be compiled, the adventures of the Gibbs meteorite should be coupled with the burial in Central Park that was effected by the Tweed dynasty for the fossil models of Prof. B. Waterhouse Hawkins.

Before leaving the room of mineralogy the visitor to the Peabody Museum should carefully examine the Blum collection of "pseudomorphs." These curiosities are crystals of shapes entirely foreign and unnatural to the mineral substances that compose them. They have been formed by a series of occurrences that may be thus summarized: first a crystal of some given kind, after forming in the shape that is natural to it, became imbedded in a rock; second, the crystal was dissolved out, leaving a mould or cavity of its own shape; third, into this mould some other mineral has penetrated while in a plastic state, and thus acquired a crystalline form that it cannot rightfully claim. The number and variety of these pseudomorphs are surprising; many of the specimens are beautiful objects. The first great collection of minerals obtained by Yale College was that of Col. Gibbs, the father of the distinguished Professor of Chemistry at Harvard. Col. Gibbs bought the collection of a Russian nobleman; it contained 10,000 specimens, chiefly from Continental Europe and Siberia; it was purchased by Yale College at a cost of $20,000, which at the time (fifty years ago) seemed an enormous expenditure. Upon the same floor of the museum there is also the private collection of minerals of Prof. Brush, used by him in the instruction of students, and of peculiar value for this purpose, as it is systematic, extensive, and very complete.

ANTIQUITIES FROM THE TOMBS.

In the fourth story of the building, when the specimens are all arranged, there will be a display for the students of archæology and ethnology quite as remarkable as anything else in the museum. For twelve or fifteen years Prof. Marsh has been gathering the materials of this display, curiosities now for the first time exhibited. The philanthropist's dream of a millennium, in which all classes of men may meet on an equality, without respect to race, color, or previous condition of servitude, is here realized. Representatives from the Esquimaux of the North to the Maoris of New Zealand, from African savages and the polished Chinese, from pre-Adamite man and the last of the Mohicans, are here present, and may be judged by their works and their skulls. Already the contents of the cases, though as yet only a few are filled, show something of the value and extent of the collections. The pottery of the Mound-Builders, which is now arranged in the cases, includes about 1,200 pieces, many of them showing high skill in construction. As a whole, this collection of ancient North American pottery surpasses any other. There are many water-jars of graceful and grotesque shapes, cooking utensils, and drinking cups, ornamented with the heads of various animals; not a few represent the human figure; some appear to have been likenesses—portraits as to the faces. One case contains a superb collection from the Pacific coast of large receptacles that look at first sight like great pieces of pottery; in reality, they are hewn out of solid stone. From all points of the Pacific coast, and especially from California and the Columbia River, innumerable stone implements and antiquities testify to Prof. Marsh's energy as a collector. From Mexico there is a variety of stone idols. Perhaps the most extraordinary of the archæological collections is one which Prof. Marsh obtained by purchase from M. de Zeltner, who was for many years the French Consul at Panama. During the Franco-German war the consul returned to Paris, bringing his curiosities with him, and there offered them for sale. There was at once a sharp competition among the European purchasers, but a cable dispatch from Prof. Marsh slipped in between their offers, he having previously journeyed through Central America, and thus become apprised of the worth of this collection. So the curiosities crossed the Atlantic again, and came back to America, where they properly belong. They are the remnants of the Chiriqui civilization, obtained from the tombs of that forgotten race. The workmanship shown in these antiquities is of a high order. Among them there is a large number of gold images, representing human and animal figures. Nearly every one of them is unique in design; the forms are strange in posture; to me they seem quite unlike anything that other civilizations have produced. As mere bullion, the value of these specimens is great; as antiquities, they are beyond price. The de Zeltner collection is also rich in stone implements, finely wrought. Prof. Marsh, while in Central America in 1871, himself obtained several objects of interest from the ancient tombs; among the rest, a statue carved out of a column of basalt—a female figure about three feet high—certainly the oldest if not the most beautiful piece of sculpture in America. Its attitude is very quaint; in the museum it is popularly known as "The Panama Venus." The collections from Central America are sufficiently full to be representative. Hence an important class of comparisons can be made: for instance, between the Chiriquis and the Mound-builders, as there is a good collection of the implements and tools of each; or with the ancient Peruvian civilization, as that is also represented here by pottery and other antiquities. And if it is desired to push comparisons still further, there will be the means here supplied in a choice collection of stone implements from Europe; another, representative of the bronze age; and still another, from the Lake Dwellings of Switzerland. Ethnology will be fully represented on this floor. The harvest of skulls here gathered will tell of every well-marked North American Indian tribe; it will show the success of at least 200 Flatheads in squeezing their craniums; will indicate what manner of men inhabited distant Pacific islands before the missionaries interfered with their manners and customs. And here, along with the abundant belongings that illustrate the life of existing tribes, Prof. Marsh will no doubt deposit his large collection of pipes, keepsakes, souvenirs from his Indian friends, chiefs of all degrees of eminence, from Red Cloud and Old-Man-Afraid-of-His-Horses down to "the Piute Chief," of Indian Ring fame. Many of the innumerable stone pipes which must find place on this floor will doubtless go into the archæological cases, but it is not clear to me where the line is to be drawn in some instances between archæology and ethnology. Perhaps such questions can be readily decided by Mr. Charles H. Farnham, the enthusiastic assistant in charge of archæology. But if abundant facilities for smoking tobacco may be cited as evidence of high civilization, the Peabody Museum can show that most of the Indian tribes were as far advanced as is Young America.—*New York Tribune.*

WHEN TO CUT GRAIN.

PRODUCTION of seed is the crowning act of vegetation, after the performance of which function most plants commence to decay, having accomplished the purpose for which they were created. When in the growth of a plant there is presented the maximum amount of good qualities, that period should mark the commencement of its harvest, and when wheat, oats and other cereals attain this point the circulation of their sap ceases, a change in color from green to yellow occurs, their power of assimilating mineral matter is destroyed, and consequently they are no longer in condition to increase their weight.

The proper time for cutting all cereals is on the maturity of the grain; when the green color of the straw, just below the ears, changes to yellow the grain cannot afterwards be more fully developed, whatever may be its stage of ripeness. Any improvement is rendered impossible by the changed condition of the upper part of the stem, indicated by its altered hue, which cuts off the supply of sap to the ears, while the latter possess no power of absorbing nutriment from the air. When these vital processes, which continually affect the growing plant, are checked, then purely chemical forces come into play; and if seed, perfectly matured, be allowed to remain unharvested, it is attacked by the forces of light and air and its good qualities suffer rapid deterioration.

In the case of wheat eminently practical authorities decide in favor of early cutting. Within three weeks of being fully ripe the straw begins to diminish in weight, and the longer it remains uncut after that time the lighter it becomes and the less nourishing, if designed for cattle food. On the other hand the ear, which is sweet and milky a month previous to being ripe, gradually consolidates, the sugar changing into starch, while the milk thickens into the gluten and albumen of the flour. If reaped at this time, when the grain contains the largest proportion of starch and gluten, which change is completed about two weeks before the grain becomes dead ripe, it will produce the most fine flour, the least bran and the greatest weight per bushel. At this period the grain has a thin skin; and hence, as it is intended for consumption as food, the less bran it contains the better. The bran, or covering of the seed, is the last part to be perfected, and the growth of the seed for several days before its perfect development is directed solely towards its covering. Since this is the least valuable part of the grain its increase is undesirable, and when in excess it is really of less value to the miller.

Careful experiments have developed the fact that wheat should be cut from ten to fourteen days before its full ripening, since it has passed its period of perfection, and has begun to lose its value several days before its complete maturity. Among the many advantages claimed for early cutting may be mentioned: Straw of a better quality, since the straw of green or greenish-yellow grain is worth double that of over-ripe straw for feeding; a better chance of securing the crop, through the earlier start on harvesting; a saving in handling, less loss by shaking off the ears and less liability of the straw breaking down, so likely to occur in fields of fully matured grain; a positive gain of about fifteen per cent. in weight of flour in equal measures of wheat, and of nearly eight per cent. in equal weights of wheat in favor of the earlier cuttings; and, finally, a flour of finer quality, less bran, more gluten and of greater market value.

The theory upon which these latter good qualities of early cut wheat is explained is that, as the sugar in the green plant becomes changed into the starch of the wheat, so if permitted to remain until fully ripe another change will take place, the starch becoming gradually converted into woody fibre, since it is a well-known chemical fact that sugar, starch and fibre are composed of essentially the same constituent elements, differing only in the quantity of water combined with their carbon. As in grasses and succulent plants, the greatest proportion of saccharine matter is present before the flower is dead ripe.

It is safe to cut grain the moment the stem changes in color and when the grain, however soft, no longer gives out a milky juice under pressure. Oats should be cut before fully ripe, and even though the straw should have a greenish hue; for if allowed to stand until dead ripe the ear is not improved, a very large percentage of the grain will be shaken out by the wind or knocked out during the process of reaping and housing; and if cut and dried while still rather green, oat straw makes superior fodder, being far more nutritious and digestible than over-dried straw. The cutting of barley should be commenced when the heads begin to droop and the ear assumes the yellowish hue. One exception only exists in the rule of early cutting of grains, and that applies to such as are intended as seed for reproduction; then it would seem desirable that the life germ or vital principle within be protected by as thick a husk or shell as possible, and such as overripening alone would produce.—*American Cultivator.*

THE SUMMER-MULCHING OF STRAWBERRIES.

WHILE it is rather late to discuss the subject for any expected benefit this year, yet the remembrance of gritty strawberries recently eaten is so fresh in mind that the following from an English exchange is much to the point: It is astonishing how often one sees the most skillful culture and painstaking skill, a wise selection of varieties, a liberal application of manure, and all the rest of it, and the product of all—a good crop of fruit—spoilt at last through want of common sense or prudence in providing a clean bed for the fruit to rest upon when ripe. During dry weather strawberries suffer but little through lying on the clean sweet earth. But let a heavy dashing shower fall and the fruit is splashed beyond possibility of future cleansing, for the soil adheres so closely to the rough surface of the strawberry that it cannot be removed, neither by rubbing nor washing. Washing! faugh! a washed strawberry is wholly ruined! and strawberries and grit are a sorry substitute for clean fruit or strawberries and cream, sweetened with sugar of the finest, free from rank flavor and from sand.

Many and various substances have been recommended for forming a summer mulching, or a clean bed, for ripe strawberries. All of them perform the compound function of conserving the moisture and strength of the soil as well as keeping the fruit free of grit. The attempt to combine a third function—that of feeding the plants as well—often proves disastrous to the flavor of the fruit, and is to be deprecated. Strawberries hardly need feeding when in fruit. The time to feed with effect and to good purpose is before planting and also during the previous summer, the winter, or early spring. When the plants show flower, the issue of that season's crop is largely determined. It may indeed afterward be wrecked by drought, but provided strawberries are kept sufficiently moist to prevent their flagging, the plants in soil of good condition, the crop thrives without extra feeding during the ripening in the open air.

Besides, mulchings rich enough to feed the roots are mostly also sufficiently rank to impart a flavor to the fruit in wet weather, and it is equally more disagreeable to eat strawberries flavored with manurial sauces than to consume them with earthy additions. Manurial mulchings too often look quite sweet and inoffensive in dry weather, when they are least needed, but when rain falls they grow rancid and set up active decomposition, to the injury of the fruit. This is especially the case with mulchings of stable or long farm-yard manure and short grass. The latter is often most offensive in this way. If put on thick enough to be efficient against earth-splashing, it is apt to decompose sufficiently to flavor the fruit. There is also this drawback to the use of short grass—the rain is apt to raise the smaller, lighter blades of grass on to the fruit. If stable litter is used for summer mulching, it ought to be put on early in the autumn to allow the winter rains to wash it clean. But even then it is not so clear and pure as spent tan, which I consider one of the best summer mulchings for strawberries. The smaller parts should be sifted out of it, and only the rougher employed. After a few washings with heavy rains it becomes as clean apparently as oak bark before being brought into contact with the hides, and forms a sweet clean bed for the fruit to lie upon. It has the additional merit of being distasteful to slugs and snails, and, moreover, it proves a capital conservator of the moisture and strength of the soil. The plants, too, seem to take kindly to tan, and, if it does not feed, assuredly it does not poison or injure them.

Clean and very rough straw also forms a good mulching for strawberries. But then it is costly, and hardly goes through the season without rotting. Rough, clean cocoa fibre refuse is cheaper and perhaps better, forming a basis at once clean, conserving, and partly and slowly enriching without any danger of flavoring or injuring the fruit.

Villa gardeners who desire to raise but few plants, and have a pride to grow and preserve these few to the highest perfection regardless of economic results, make use of strawberry tiles, with a semi-circular hole in the center of each tile so that they can be placed together with the plant through the middle. They are a cleanly, convenient, and effective though costly mode of summer mulching strawberries. Each grower can select such material for mulching as is at once most convenient and economical for him.

THE PEACH.

WHEREVER the climate is suited to its growth the peach is the most common and most easily obtained of all the fruits. The trees are more tender and of shorter duration than most fruit trees of temperate climates. In some localities they bear only two or three good crops and then decline or perish; on favorable soils they continue for twenty or thirty years, and in some instances even longer, while in European countries, where a rigid system of annual pruning is followed, peach trees have lived to an age of 100 years.

The most extensive peach-growing regions are in New Jersey, Delaware, Maryland, and in recent years many portions of the West, some orchards containing 40,000 or 50,000 trees. The destruction of the peach crop is caused in nearly all cases by the intense cold of winter, for, notwithstanding the peach will endure severe cold weather, even 20° or 25° below zero, yet it often happens that we have a few days of mild or even warm weather during the winter, sufficient to swell the buds slightly or to throw moisture enough into them to render them tender; and then if the thermometer sinks a few degrees below zero, there is but little hope for the future crop of the succeeding season. Spring frosts seldom have any influence.

The peach tree is of remarkably easy and rapid propagation. Stones or pits properly planted in the fall will usually

sprout in the spring. In extremely rare instances seedling trees have borne the second year, or sixteen months from the planting of the stone. Stocks may be budded the first summer, affording trees five or six feet high the second autumn. Transplanted the second year from the bud, the trees, with good cultivation, usually come into bearing about the third year afterward.

The chief food of the peach is lime, potash, and bone-dust; consequently on soils where these are naturally in abundance, or where they are plentifully supplied, the largest crops of healthy and vigorous fruit will be produced. In the proper cultivation of this valuable fruit, keep the ground clean and mellow around the trees, and give it an occasional dressing of wood-ashes; keep the heads low; the trunk ought not to exceed two and a half to three feet in height; attend regularly every spring to pruning and shortening the shoots of the previous year's growth. This keeps the head round, full, and well furnished with bearing wood. Cut weak shoots back one-half and strong ones one-third; but see that a sufficient supply of fruit buds are left, while all sickly and superfluous shoots should be cut out clean.

A rich, deep, mellow loam, with a slight admixture of sand, is the best suited for the growth and perfection of the peach. On a strong loam, the trees grow with more uniform luxuriance and live longer than on light, sandy, or gravelly soils. On the light sands of the peach-growing States orchards succeed and bear well for a time, yet they do not endure so long nor remain so free from insect enemies as in other soils, better adapted to the nature of the peach. The varieties are very numerous, yet those which are marketed in large quantities are confined to a few well-known and long-tried kinds. It would seem that, with the exception of the extreme northern part of the United States, almost every farmer might enjoy the luxury of a few peaches of his own raising, even if he did not desire to compete for the market with a much larger crop.—*Boston Cultivator.*

BIRD'S-EYE MAPLE.

THIS beautiful wood is found in Europe, Russia, and America, but it is with the American that the present article deals, as being best known in England, so says a London paper. Mottled maple is also a native of the latter continent, and is principally used for picture frames. The grain of the bird's-eye maple varies, as the saw divides the eyes transversely or longitudinally, and pieces cut out in circular sweeps, such as chair backs, sometimes exhibit both the bird's-eye and the mottle, at different parts. The occurrence of eyes, zones, spots, and small curls in the wood gives rise to figures of great beauty. Of the wood so marked, bird's-eye maple, amboyna wood, the roots or butt of the common yew, and the common maple, are, perhaps, the most beautiful. The knobby tubercles that form in the root and trunk of the common elm from the repeated stripping off of the side branches, as is the general practice around London, afford, occasionally, very fine specimens, which are known by the name of "curled elm."

The maple was highly prized by the Romans, especially that which grew in Istria and Bœotia, and was distinguished by its curled peacock-tail veins. Pliny says it exceeded even the *citrus* in value, but could be obtained only in small pieces, for writing desks and similar articles. The bird's-eye maple shows, in finished work, the peculiar appearance of small dots or ridges, or of little conical projections, with a small hollow in the center, but without any resemblance to knots, the apparent cause of ornament in woods of similar character, as the burrs of the yew, and kiaboca and the Russian maple (or birch-tree), and this led Mr. Holtzapfel to seek a different cause for its formation. He states that, on examination, he found the stem of the bird's-eye maple of America, when stripped of its bark, presented little pits or hollows, as if made with a conical punch, others ill-defined and flattened, like the impression of a hob-nail. Suspecting these indentations to arise from internal spines or points in the bark, a piece of the latter was stripped from another block, when the surmise was verified from its appearance. The layers of wood being molded upon these spines, each of their fibres is abruptly curved at the respective places, and when cut through, they give, in the tangential slice, the appearance of projections, the same as some rose-engine patterns, and the more recent medallic engravings, in which the closer approximation of the lines at their curvatures causes these parts to be more black (or shaded), and produces upon the plate-surfaces, the appearance of waves and ridges, or of the subjects of the medal.

ORIGIN OF THE TREES AND SHRUBS IN THE SOUTH OF FRANCE.

IN a recent memoir presented to the Academy of Sciences of Montpellier, the veteran professor Charles Martins discusses the history of those trees and shrubs in the south of France which suffer from severe cold, such as the carob-tree, oleander, European palm, myrtle, sweet-bay, pomegranate, olive, fig, laurustinus, ilex, vine, and others. He shows that most of these occur among the tertiary and quaternary deposits, that some of them, indeed, like the oleander (*Nerium oleander*), go back even into eocene times. He points to the fact that their remains occur in the geological formations, not only of the countries where the plants are still living, but even of tracts considerably further to the north, both in France and in Switzerland, where their living descendants or analogues could not endure the severity of winter now. The tender trees and shrubs of the Mediterranean seaboard thus serve to prove the former warmer climate of France and its subsequent refrigeration. They are merely the surviving relics of a tertiary vegetation preserved by the exceptional mildness of the climate in which they grow. A single winter of exceptional rigor, or even a single night of extreme cold, like that of January 13, 1826, when the thermometer fell to 9°·7 below zero (Cent.), would suffice to destroy them. It may be presumed, however, that during at least the height of the glacial period these tender plants were driven southwards beyond their present northern limits, and that they have subsequently crept north again.

IT is very difficult for the people in the East to realize the immensity of our redwood trees, and we do not wonder at their incredulity. But their enormous size is a fact, nevertheless. For instance, Murphy Brothers, of this county, cut down and sawed into lumber at their mills a few years ago, a tree that measured 375 feet in length and 10 feet in diameter, clear of bark. This tree made by actual measurement 37,000 feet of dressed lumber and 16,000 feet of rough, which sold at the mill at usual prices for $1,080. Other trees in this county measure much larger in diameter, but very few make more lumber than this one.—*Sonoma* (*Cal.*) *Democrat.*

THE CARPET BUG.

By DR. J. A. LINTNER.

A DESCRIPTION of this serious pest (*Anthrenus scrophulariæ*), which is exciting so much attention in many homes, has been given in former communications, but as it has failed to come to the notice of many housekeepers, we will again give a description, more precise than before, which will serve to identify it:

It is now in its larval state, that in which it will present itself during the present time—the summer months—if search be made for it, in infested dwellings, beneath the edges of carpets. Two or three tacks are to be quickly drawn up, and the carpets turned back, when from the portions where the tacks held the carpet closely to the floor, several oval, dark brown, hairy little creatures will be seen, traveling with a rapid gliding motion, to find concealment beneath the base-boards or in the floor crevices. On the instant finish their existence with a blow of the tack-hammer, or they are gone; or if one is to be preserved for closer examination, scoop it up with a piece of blotting paper and drop it into a glass bottle and cork it up. Its body will be found to measure about three-sixteenths of an inch in length, with a number of hairs radiating from its last segments in nearly a semi-circle, but more thickly clustered in line with the body, forming a tail-like projection nearly as long as the body—the entire length being, in the largest specimens, nearly three-eighths of an inch. Measured across the body, including the lateral hairs, its breadth just equals the length of the body. An ordinary magnifier will show the front part of the body, where no distinct head is to be seen, thickly set with short brown hairs, and a few longer ones. Similar short hairs clothe the body, somewhat longer on the sides, where they tend to form small tufts. Toward the hinder end of the body, may be seen on each side, three longer tufts (thrice as long) projecting laterally; but these are not always visible, as the insect has the power of folding them out of sight along its sides. The body has the appearance of being banded in two shades of brown—the darker band being the central portion of each ring, and the lighter, where they connect, known as the incisure. By turning it over on its back, the six little legs, of which it makes such good use, can be seen, struggling to regain its former position—its struggles while in this condition sometimes producing a series of jumps of about an eighth of an inch in length.

Having attained its full growth, it prepares for its pupal change without the construction of a cocoon or any other provision than merely seeking some convenient retreat. How it remains in a quiet state, unaltered in external appearance, except somewhat contracted in length, until it has completed its pupation, when the perfectly formed insect within bursts the skin of the larva in which the pupa had been contained, and through the fissures upon the back emerges as the perfect insect.

The earliest beetles appear in the month of October, and continue to make their appearance during the fall, winter, and spring months. Soon after their appearance probably they pair, and the females deposit their eggs for another brood of the carpet-eating larvæ.

The beetle is quite small—smaller than would ordinarily be expected from the size of the larva—being only about one-eighth of an inch long by one-twelfth broad. An average of five examples before me gives length .125 in., breadth .085 in. Its form is almost a perfect ellipse as seen from above, its back and under surface are quite rounded. When turned upon its back it often for a few moments counterfeits death, with its legs so closely folded to the surface as scarcely to be seen, and in this state the ordinary observer might be at a loss to tell the lower from the upper side.

It is a beautifully marked little insect in its contrasting colors of white, black, and scarlet, arranged as follows: The edge of each wing-cover, where they meet on the back, is bordered with red (forming a central red line—with three red projections from it outwardly—one on the middle of the back and one other toward each end. Take a straight line and divide in four equal parts by three cross lines, and we have nearly the position of these projections. At the extreme tip of the wing-covers is a widening of the bordering line, making almost a fourth projection from it. The first projection, near the head, is connected with a white spot, running upwardly on the middle of the front border in the wing-cover. On the outer border of the wing-covers are three white spots nearly opposite the red projections. The intermediate spaces are black. The segments of the body beneath are covered with pale red scales, and the thoracic region (which bears the legs) with whitish scales.

The above description, although not presented as a scientific one, is sufficiently precise for the identification of the beetle when met with.

I have this present year found that a very good place in which to discover the beetle is upon the windows of the infested rooms during the day. In the latter part of April examples were taken upon the windows of my residence at Schenectady. After the middle of May a regular search instituted for them gave several examples each day. In the six days from May 17th to 22d, forty-four specimens were taken from the three windows of the two upper rooms. Should investigation show that the beetle is drawn to the windows before the deposition of its eggs, their ready capture and destruction at this time will offer an easy method of preventing their increase.

The recommendation in several of our newspapers, recently made, of the Persian insect power for the destruction of the insect, I believe to be of no value. I have not deemed it worth the trouble of experimenting with it, but I have been told by those who have given it a trial that it has been found to be of no avail whatever. At the present time I know of no more efficient agent to employ against this annoying pest than caulking the crevices beneath the baseboards, and of the floors for a foot or two adjacent, with cotton, saturated with kerosene oil, during the fall months, when the larger portion of the brood is in the egg or pupal state, to either of which form the application of the oil will prove fatal.

The insect has not as yet become sufficiently abundant in New York to be found resorting to plants for its food. The variety of this species formerly known as *Anthrenus lepidus*, which was introduced in California sufficiently long ago to permits its complete naturalization, was discovered there, in numbers, feeding upon some of the compositæ. Another species of the genus, the *Anthrenus varius*, is often found, in its perfect state, taking its food from the blossoms of different plants in the garden and field. I have met with it abundantly on peonies. It has also been found to frequent the rocket flower, *Hesperis matronalis*, a fragrant and showy perennial.

If the plants known to be attractive to the *A. varius* can be introduced into our houses, and made to flower during the months of April and May, I believe that the carpet beetles would be drawn to them in preference to windows, perhaps as soon as they emerge from the pupæ. I apprehend that it will be found important to resort to every means known to us to protect ourselves from the ravages of this insect, where it has once established itself.

It is announced as having appeared in considerable force in Syracuse. Its presence has also been detected in Albany, but no serious ravages have been reported. Without doubt it is committing its depredations in many localities where its work is ascribed to the carpet moth, than which it is a far more pernicious insect. Every prudent housekeeper would do well to institute search from time to time for it, that it may be discovered if present, and prompt measures instituted against its increase.

A lady, to whom I was relating the destructive capabilities of the new pest, congratulated herself that her carpets were free from it. The following morning her husband brought to me a beetle which he had taken from his face during the night, which proved to be the creature that I had described to her the previous evening—the presence of which in her home, in numbers, she had not suspected.—*Country Gentleman.*

WONDERFUL KENTUCKY CAVES.

IN wild scenery, as wild and disordered as her elements of society, Carter county ranks second to no county in the State. Her mountains of limestone formation seem to have been rent asunder "from turret to foundation-stone" for roaring torrents in the springtime, like Taygert and Buffalo Creek, to boil through, and others to have upheaved, leaving huge fissures and caverns, many of which are explored, but all of which to the world at large are little known. The caves are ten miles from Greyson, the county seat, in a northwesterly direction. The road to them is rocky in the extreme, and barely passable for wagons, part of the time running on lofty ledges, in the bottom of creeks, and down steep declivities and up hills of well nigh perpendicular steepness.

Decidedly the largest, most remarkable, and geologically the most interesting, is the Bat Cave, named from the swarms of bats that, when winter sets in, here come to cling to the walls and roofs in a long three months' hibernation. In clusters and groups closely matted together, their feet at their wings' ends seize hold of the crystal corrugations and wall roughnesses with a strength of hold and pertinacity of grip that defies easy removal. They resemble a plate of silk buttons, for only their silklike heads are visible, so closely are they matted together. This cave is very damp, and the west end, which we entered, is about a mile from the house. The entrance is a huge yawning opening at the base of an immense limestone bluff. It is fifty feet wide at the opening, and averages a width of twenty-five feet, though sometimes extending over a width of one hundred and fifty feet through its entire length of two miles. The bottom is very rough for a distance of nearly half way, huge boulders and piles of sand and gravel having been washed in by high water. The explorer must watch well his footsteps, for now he treads on soft gravel, then climbs over slippery and tottering rocks, and anon plunges in cold water knee-deep that chills like ice. Bats flit all about you, and brilliant stalactites flash from every corner, hang drooping from the walls, jut out at the sides, or lay in huge or ill-shaped masses on the floor of the cave.

About one hundred and fifty yards from the entrance is the Secret Chamber, so called from the difficulty of finding one's way out. It is half a mile in length and full of recesses, pits, and shoots. About a quarter of a mile beyond to the right is the Grotto. Crawling between two mammoth rocks barely wide enough to admit the passage of even a lean person for about fifteen feet, a beautiful grotto is discovered, from the ceiling of which hang long and slender stalactites, some of which are three feet in length. A rock weighing several tons, its surface resembling a beef's paunch or coral reef (sponge coral) containing a vein a foot wide of cream-colored quartz, was shown as a great curiosity. After advancing about three quarters of a mile the roof was found to have shelved off in large cakes, and immense shelves jutted out from the sides, some twenty feet square. On the floor are a series of basins lined with minute crystals and seamed with fine needlework lines and delicate etchings. In the wet seasons these basins fill with water, on the top of which a scum forms, which in two weeks or a month forms rock. This settles to the bottom and crystallizes.

The Fork, as it is called, is about a mile from the entrance. To the left flows the stream of water, to the right a long passage way, that comes out at the same place where the stream makes its exit. The slope of two hundred yards that must now be passed is back-breaking. About four feet in height, and just wide enough to admit of the passage of a moderately sized person, it is indeed a fat man's curse. Of the names on the wall, the oldest date is 1835, but the most noteworthy name perhaps is that of Thomas McClees, who is still living on Buffalo Creek, at the advanced age of eighty five years, and who worked in the Swingle Cave in 1812. The circular cavern is a hundred feet in diameter, has four entrances, and is near the east end. The bath room is near, too. It is six hundred feet in length and has icy cold water four feet deep. The east entrance has two openings, a larger and smaller one. The larger, thirty feet wide and twenty high. The smaller, fifteen by ten. Through the larger entrance four spans of horses could be easily driven abreast. The formation of the eastern entrance is what is called bastard limestone, of a bluish color. The formation of the caves is limestone, and beneath sandstone.

Not far from the eastern entrance of the Bat Cave is a natural bridge, through which six spans of horses could be driven with ease, having a width of forty feet, and height of fifty feet, and length of longest curve two hundred and fifty feet.—*Correspondence Cincinnati Enquirer.*

FISH CULTURE.

THERE are few enterprises enjoying public attention at the present time that promise more profitable results than the multiplying of food fishes in fresh water ponds. It is the belief of all who have studied the subject, that fresh water fishes of all kinds can be multiplied almost indefinitely, and so cultivated as to be improved not only in quantity but in quality, and made to be the *cheapest of cheap food.* The fact should be repeated over and over again, until every one who has a patch of water on his premises large enough for tadpoles and shiners, can make it yield an abundance of wholesome fish food, at not half the trouble and expense with which he cultivates a like patch of ground. The food thus produced is too much neglected by the farming community; it affords elements of nourishment necessary to a healthy condition of the body, for which no cheaper available substi-

tute can be found. There are 256 ponds of from 5 to 2,000 acres each, aggregating 31,604 acres in Connecticut, which contain a considerable number and variety of food fishes—although probably not a thousandth part of what this may be made to produce at a little expense of time and money. Besides these (256) large ponds, there are a greater number of ponds of less than 5 acres each, that are in like manner capable of development.—*Connecticut Fish Commissioners.*

AN INSECT ROSE THORN.

AT a recent meeting of the San Francisco Microscopical Society, Col. C. Mason Kinne presented some curious forms of insect life, which were obtained by Mr. Thos. F. Eyre, from a tree and rose-bush under the same, growing at Mazatlan, Mexico. They were mistaken by the casual observer for the thorns which are the proverbial necessary evils of the sweet smelling rose, from the fact that the thorax being raised into a sharp-pointed crest, which had the appearance and feeling of a veritable rose thorn. Mr. Kinne remarked that the tree-hoppers (*membracidæ*) furnish many varieties of this peculiar form of raised thorax, but the variegated sharp crest, curving upward and backward from the head of this, gives perhaps, as beautiful an illustration as is found of the genus. In the struggle for existence which has gone on for ages in the animal kingdom, the "mimicry of nature" plays an important part, and this little tree-hopper, from its appearance and known habits, is a good example of the theory.

LOBSTER BURYING ITS PREY.

TOWARDS the end of February last we had occasion to empty a tank containing flat-fishes, and a flounder of eight inches in length was inadvertantly left buried in the shingle, where it died. On refilling the tank it was tenanted by three lobsters (*Homarus marinus*), one of which is an aged veteran of unusual size, bearing an honorable array of barnacles; and he soon brought to light the hidden flounder, with which he retired to a corner. In a short time it was noticed that the flounder had disappeared. It was impossible the lobster could have eaten it all in the interim, and the handle of a net revealed the fact that, upon the approach of the two smaller lobsters, the larger one had buried the flounder beneath a heap of shingle, on which he now mounted guard. Five times within two hours was the fish unearthed, and as often did the lobster shovel the gravel over it with its huge claws, each time ascending the pile and turning his bold defensive front to his companions. I am not aware that this canine propensity of the lobster has been before recorded.—*E. E. Barker in Zoologist.*

ON THE PROPRIETY OF LIMITING FAMILIES.

SOME forty years ago a Boston physician, respectable, we believe, but not eminent, Dr. Knowlton, impressed with the political doctrines of the eminent clergyman and political economist, Malthus, wrote a small book advocating the limitation of childbearing in married life.

Mr. Malthus, writing in 1798, and his followers, F. Place, John and James Mill, Ricardo, Senior, Fawcett, Cairnes, and a host of economists, have shown that there is a constant *tendency* in all animated beings, including mankind, to increase more rapidly than the means provided by nature for subsistence. In our race a woman commences to menstruate at fifteen, and continues apt for reproduction until the age of forty five, or thirty whole years, during which time she might easily, on an average, give birth to twelve or fifteen children, if in good health. It is this constant *tendency* toward rapid reproduction which causes the present most unsatisfactory state of hygiene among the poorer classes in over-peopled countries. In the United States the tendency to increase rapidly is evinced by the fact that ever since 1780 the population was doubled in some twenty to twenty-five years, in many instances entirely without counting immigrants. England has never doubled its numbers more rapidly than in some fifty-two years. Hence, it is as clear as a sum in addition that the English, and especially the French, who remain stationary in numbers together, must have had their increase checked by some causes. In England these causes are infant mortality, celibacy of women, and prostitution (which induces barrenness). In France the population has been mainly kept down by the enforced celibacy of army life, and by the avoidance of large families among the married.

The propriety of this latter step has been insisted upon by many eminent sociologists. The distinguished philosopher, John Stuart Mill, exclaims, in one of his essays, "Little advance can be expected in morality until the production of a large family is regarded in the same light as drunkenness, or any other physical excess."

Impressed with his views, a society in England lately reprinted Dr. Knowlton's book; but the bigotry of some English conservatives could not bear the discussion of the question, and the society was prosecuted. The result was, its representatives were acquitted, and the sale of the book rose, from a total of 500 copies before the trial, to 125,000 copies since the indictment was lodged! Thus does fanaticism defeat itself.

The English medical weeklies have all discussed the subject, and with their usual timidity. They do not pretend to attack Mill's arguments; they only deprecate the publicity given to what they call the discussion of a dangerous topic. Fortunately this country was educated in the principles of Thomas Jefferson, and taught from its infancy that the surest way to rob a topic of danger to the commonwealth is by the fullest and freest public discussion of it.

We have not seen Dr. Knowlton's book, and so we cannot speak of its merits or demerits. But as a physician and sociologist we have repeatedly stated in this journal that the subject he discusses is one of grave import, proper and necessary for both professional and general consideration, one which no prejudice nor bigotry can much longer keep in the shade. If the book in question, as was alleged, treats of it in a way to encourage immorality, physicians are to blame that it is so; they could and they should present the matter, as it can be presented, as a topic of general social welfare, freed from this immoral tendency. All knowledge can be abused; but that is no reason for preferring ignorance on any subject; and the absurd position that our only or chief safeguard against sexual immorality is the fear, entertained by one or both parties, that bastardy may result, is a most discreditable, and for this country, a most false, notion. If English women are chiefly restrained from profligacy by this fear, it is not so with the women of the United States, and we do not believe that the general knowledge of the "preventive checks" to having offspring would add in any appreciable manner to sexual vice. This opinion is not theoretical. Every city physician knows that these checks are perfectly well known to the "men about town," the libertines and "fast fellows;" but he also knows, from the confessional of his back office, that these men do not pretend to have derived much or any aid from them in their unlawful amours. The nation that trusts to the fear of bastardy to keeping its women in the path of virtue, rather than to religious training, moral principles, and a knowledge of the sacred duties of wife and mother, takes a position which we should be sorry to see assumed in defence of American women, and one which, for ourselves, we scout and repudiate in their behalf.—*Medical and Surgical Reporter.*

HORSE DENTISTRY.

IT is generally believed, even among the best horsemen in the country, that glanders is quite prevalent among horses. Many a valuable animal has been killed by direction of his owner because of an offensive discharge from the nostrils, which has been considered as a sure indication that the horse is affected with that dreaded disease—glanders. The fact is, says the Worcester *Spy*, cases of glanders are few and far between.

C. D. House, the celebrated veterinary dentist, who is known by all horsebreeders and owners of note from the Atlantic to the Mississippi, was in the city recently, and says that in all his experience he has never known of but two cases, although he has known of hundreds of instances when horses have been killed because they were supposed to be affected with this disease. The whole trouble arises from neglect of the teeth, and this alone causes more difficulty than any of the ailments to which horses are subject. The famous sire, Rysdyk's Hambletonian, was killed by the toothache, and other valuable horses have died from the same cause.

The offensive discharge from the nostrils, so closely resembling the discharge in cases of glanders, arises from the teeth, which, becoming detached, are forced up into the head and cause ulcers to form, which continue to increase in size until they burst, and the secretions escape from the nostrils.

Bunches below the eyes and upon the face of a horse are nearly always the result of troublesome teeth, and many a horseman has noticed that these bunches disappear with the cessation of a discharge from the horse's nostrils, and form again soon after the discharge ceases.

A few days ago Mr. House operated upon the horses of the Hambletonian Breeding Stud, Dr. Flagg, C. M. Dyer, Washburn, and Vaughn, and W. G. Strong, pulling or cutting or filling the teeth of nearly every animal he examined. In one of the horses' mouths the wolf teeth were found to be entirely covered by the gum, and detached from the jaw so that every time the bit was moved in the horse's mouth these teeth were turned, crowded, and jammed into the gum, of course causing the horse to jump and run.

Another case was found where the grinders had been worn rough and uneven, and were slightly displaced, so that the horse, in eating, was continually grinding away upon the inner lining of the mouth, keeping it constantly raw and painful, and of course making the beast cross and irritable. Still another case was where one of a colt's temporary teeth, after being partially forced from its place by the second teeth, had remained fastened by one fang, and in such a position as to grind continually upon the gum while the animal was feeding; and yet so nicely had the decaying tooth been lodged, that its presence was only detected by the offensive odor arising therefrom.

Several cases of inflammation of the gums were found, which were accounted for by the presence of tartar on the front teeth, which was readily removed. Mr. House's operations recently were closely watched by a large number of horsemen, and many who were unable to account for sensitive mouths in their own horses became satisfied that the trouble was with their teeth.

His method of operating is so simple that it astonishes many a horseman. He uses no gag, and the animal stands free, even without a head stall, this being his only method of operating. He claims that there are no vicious horses, but admits that there are vicious men who have made quiet horses cross and unmanageable. He has operated successfully upon such horses as Edward Everett, probably the most vicious biter in the country; Judge Fullerton, who frequently uses his teeth in any but a gentle manner; Emperor, owned by S. D. Houghton, of this city, who cannot be sponged out on the track; Goldsmith Maid, Smuggler, and in fact almost every horse of note in the country.

The animals rather appear to like having their mouths worked upon, and Mr. House says he never had one attempt to bite him. He runs his hands and arms into their mouths freely, works away upon the sensitive parts without causing the horse to exhibit signs of pain or uneasiness. His work relieves suffering on the part of dumb animals, and makes them better servants.

A JOYFUL SOUND FOR THE DEAF.

M. BONNAFONT, of the Paris Academy of Sciences, has brought before that body a case in which deafness of long standing had been cured by trepanning the tympanic membrane. The tympanum must be anæsthetized and the canula allowed to remain until it drops out naturally. Unless the acoustic nerves are weakened, he believes that any deafness may be remedied or absolutely cured by this process

REPLANTATION OF A TOOTH.—On the 6th of May, 1876, a young man came to my office suffering with toothache of the right superior lateral incisor. He refused to submit to any treatment of the tooth, and insisted on its extraction, which was done. After examination I concluded to try the experiment of replanting it. After filling the root and crown and removing the pus-sac, and taking off a small portion of the root, which had been partially absorbed, I replaced it, securing it in place by fastening it to the adjoining teeth on either side with silk thread. The fastening after a few days was removed. More than a year has elapsed since the experiment was made, and it has proved to be a complete success. The young man tells me that he knows no difference between that and his other teeth.—E. H. LOCKE, *in Dental Cosmos.*

DETERMINATION OF ALBUMEN IN URINE.

ACCORDING to J. Stolnikow, urine containing albumen is diluted with water, until a sample poured upon some nitric acid contained in a test tube produces still a faint white ring at the point of contact, after a lapse of forty seconds. The number of volumes of water added to the volume of the urine (which may be taken as one) is divided by 250, and the quotient will be the percentage of albumen in the urine. This relation has been established and confirmed by gravimetric determination.

HUXLEY ON PHYSIOLOGICAL KNOWLEDGE.*

THE chief ground upon which I venture to recommend that the teaching of elementary physiology should form an essential part of an organized course of instruction in matters pertaining to domestic economy, is that a knowledge of even the elements of this subject supplies those conceptions of the constitution and mode of action of the living body and of the nature of health and disease, which prepare the mind to receive instructions from sanitary science.

It is, I think, eminently desirable that the hygienist and the physician should find something in the public mind to which they can appeal; some little stock of universally acknowledged truths, which may serve as a foundation for their warnings, and predispose towards an intelligent obedience to their recommendations.

Listening to ordinary talk about health, disease and death, one is often led to entertain a doubt whether the speaker believes that the course of natural causation runs as smoothly in the human body as elsewhere. Indications are too obvious of a strong, though perhaps an unavowed and half unconscious, undercurrent of opinion that the phenomena of life are not only widely different in their superficial characters and in their practical importance, from other natural events; but that they do not follow in that definite order which characterizes the succession of all other occurrences, and the statement of which we call a law of nature.

Hence, I think, arises the want of heartiness of belief in the value of knowledge respecting the laws of health and disease, and of the foresight and care to which knowledge is the essential preliminary, which is so often noticeable; and a corresponding laxity and carelessness in practice, the results of which are too frequently lamentable.

It is said that, among the many religious sects of Russia, there is one which holds that all disease is brought by the direct and special interference of the Deity, and which, therefore, looks with repugnance upon both preventive and curative measures, as alike blasphemous interferences with the will of God. Among ourselves, the "Peculiar People" are, I believe, the only persons who hold the like doctrine in its integrity, and carry it out with logical rigor. But many of us are old enough to recollect that the administration of chloroform in assuagement of the pangs of childbirth was, at its introduction, resisted upon similar grounds.

I am not sure that the feeling, of which the doctrine to which I have referred is the full expression, does not lie at the bottom of the minds of a great many people, who would yet vigorously object to give a verbal assent to the doctrine itself. However this may be, the main point is that sufficient knowledge has now been acquired of vital phenomena to justify the assertion that the notion that there is anything exceptional about these phenomena receives not a particle of support from any known fact. On the contrary, there is a vast and an increasing mass of evidence that birth and death, health and disease, are as much parts of the ordinary stream of events as the rising and setting of the sun, or the changes of the moon; and that the living body is a mechanism the proper working of which we term health, its disturbance, disease; its stoppage, death. The activity of this mechanism is dependent upon many and complicated conditions, some of which are hopelessly beyond our control, while others are readily accessible and are capable of being indefinitely modified by our own actions. The business of the hygienist and of the physician is to know the range of these modifiable conditions, and how to influence them towards the maintenance of health and the prolongation of life; the business of the general public is to give an intelligent assent and a ready obedience based upon that assent, to the rules laid down for their guidance by such experts. But an intelligent assent is an assent based upon knowledge, and the knowledge which is here in question means an acquaintance with the elements of physiology.

It is not difficult to acquire such knowledge. What is true to a certain extent of all the physical sciences is eminently characteristic of physiology—the difficulty of the subject begins beyond the stage of elementary knowledge, and increases with every stage of progress. While the most highly trained and best furnished intellect may find all its resources insufficient when it strives to reach the heights and penetrate into the depths of the problems of physiology, the elementary and fundamental truths can be made clear to a child.

No one can have any difficulty in comprehending the mechanism of circulation or respiration, or the general mode of operation of the organ of vision; though the unraveling of the minutiæ of these processes may, for the present, baffle the conjoined attacks of the most accomplished physicists, chemists, and mathematicians. To know the anatomy of the human body, with even an approximation to thoroughness, is the work of a life, but as much as is needed for a sound comprehension of elementary physiological truths may be learned in a week.

A knowledge of the elements of physiology is not only easy of acquirement, but it may be made a real and practical acquaintance with the facts, as far as it goes. The subject of study is always at hand in oneself. The principal constituents of the skeleton, and the changes of form of contracting muscles, may be felt through one's own skin. The beating of one's heart, and its connection with the pulse may be noted; the influence of the valves of one's own veins may be shown; the movements of respiration may be observed; while the wonderful phenomena of sensation afford an endless field for curious and interesting self-study. The prick of a needle will yield, in one's own blood, material for microscopic observation of phenomena which lie at the foundation of all biological conceptions; and a cold, with its concomitant coughing and sneezing, may prove the sweet uses of adversity by helping one to a clear conception of what is meant by "reflex action."

Of course there is a limit to this physiological self-examination. But there is so close a solidarity between ourselves and our poor relations of the animal world that our inaccessible inward parts may be supplemented by theirs. A comparative anatomist knows that a sheep's heart and lungs or eye must not be confounded with those of a man; but so far as the comprehension of the elementary facts of the physiology of circulation and of respiration and of vision goes, the one furnishes the needful anatomical data as well as the other.

Thus it is quite possible to give instruction in elementary physiology in such a manner as not only to confer knowledge, which, for the reason I have mentioned, is useful in itself; but to serve the purposes of a training in accurate observation, and in the methods of reasoning of physical science. But that is an advantage which I mention only incidentally, as the present conference does not deal with education in the ordinary sense of the word.

* Address before the Domestic Economy Congress.

It will not be suspected that I wish to make physiologists of all the world. It would be as reasonable to excuse an advocate of the "three R's" of a desire to make an orator, an author, and a mathematician of everybody. A stumbling reader, a pothook writer, and an arithmetician who has not got beyond the rule of three, is not a person of brilliant acquirements; but the difference between such a member of society and one who cannot either read, write, or cypher is almost inexpressible; and no one nowadays doubts the value of instruction, even if it goes no further.

The saying that a little knowledge is a dangerous thing is, to my mind, a very dangerous adage. If knowledge is real and genuine, I do not believe that it is other than a very valuable possession, however infinitesimal its quantity may be. Indeed, if a little knowledge is dangerous, where is the man who has so much as to be out of danger?

If William Harvey's life-long labors had revealed to him a tenth part of what may be made sound and real knowledge to our boys and girls, he would not only have been what he was, the greatest physiologist of his age, but he would have loomed upon the seventeenth century as a sort of intellectual portent. Our little knowledge would have been to him a great, astounding, unlooked-for vision of scientific truth.

I really see no harm which can come of giving our children a little knowledge of physiology. But then, as I have said, the instruction must be real, based upon observation, eked out by good explanatory diagrams and models, and conveyed by a teacher whose knowledge has been acquired by study of the facts, and not the mere catechismal parrot work which too often usurps the place of elementary teaching.

It is, I hope, unnecessary for me to give a formal contradiction to the silly fiction, which is assiduously circulated by fanatics who not only ought to know, but do know, that their assertions are untrue, that I have advocated the introduction of that experimental discipline which is absolutely indispensable to the professed physiologist, into elementary teaching.

But while I should object to any experimentation which can justly be called painful for the purpose of elementary instruction, and while, as a member of a late royal commission, I gladly did my best to prevent the infliction of needless pain for any purpose, I think it is my duty to take this opportunity of expressing my regret at a condition of the law which permits a boy to troll for pike, or set lines, with live frog bait, for idle amusement; and at the same time lays the teacher of that boy open to the penalty of fine and imprisonment if he uses the same animal for the purpose of exhibiting one of the most beautiful and instructive of physiological spectacles, the circulation in the web of the foot. No one could undertake to affirm that a frog is not inconvenienced by being wrapped up in a wet rag, and having his toes tied out; and it cannot be denied that inconvenience is a sort of pain. But you must not inflict the least pain on a vertebrated animal for scientific purposes (though you may do a good deal in that way for gain or for sport) without due license of the Secretary of State for the Home Department, granted under the authority of the Vivisection Act.

So it comes about, that in this present year of grace, 1877, two persons may be charged with cruelty to animals. One has impaled a frog and suffered the creature to writhe about in that condition for hours; the other has pained the animal no more than one of us would be pained by tying strings round his fingers and keep him in the position of a hydropathic patient. The first offender says, "I did it because I find fishing very amusing," and the magistrate bids him depart in peace, nay, probably wishes him good sport. The second pleads, "I want to impress a scientific truth, with a distinctness attainable in no other way, on the minds of my scholars," and the magistrate fines him five pounds.

I cannot but think that this is anomalous, and not wholly a creditable state of things.

PHOTO NOTES.

By PROFESSOR E. STEBBING.

AT a recent meeting of the Photographic Society of France, M. Magny presented some very fine proofs which he had obtained by the emulsion process. We are greatly indebted to M. Chardon for the great *élan* given to emulsions in this country; for before his presentation, and the publicity given to his process, very few manipulators had succeeded in making good emulsions.

M. Braun presented some admirable proofs (in carbon), being reproductions of pictures in the late *Salon* of 1877.

M. Schaeffner presented to the Society a new transfer-paper, by which line drawings, reproductions, etc., can be transferred to lithographic stones with the greatest ease.

M. Gougenheim—well known in Paris for his success in the enamel process—gave a very good formula for a rapid collodion, together with a suitable developing solution.

A Member said he had had great success with the collodion as prepared by M. Gougenheim, and especially with the iron developing solution as proposed by that skillful operator.

The formula is as follows:

Collodion.

Ether	8239	grains.
Alcohol	6236	"

Cotton.

Double iodide of cadmium and potassium.	77	grains.
Iodide of ammonium	62½	"
" cadmium	38	"
Bromide of "	46½	"

Iron Solution.

Distilled water	15,400	grains.
Double sulphate of iron and ammonia	770	"
Sulphate of copper	308	"
Acetic acid	539	"
Alcohol	308	"

Intensifying Solution.

1. Distilled water	7700	grains.
Acetic acid	308	"
Alcohol	1386	"
2. Distilled water	1540	"
Nitrate of silver	77	"

ANTI-PHOTOGENIC COLORS.

M. Brady has made a discovery which will render great service to the photographic community—which is that of an anti-photogenic dye or color. It is well known how difficult it is to choose a yellow-colored pane of glass for the dark room which will intercept the actinic rays. This M. Brady has found to be almost impossible; so, to turn the difficulty, as it were, he experimented with a number of dyes, and has succeeded in discovering one admirably adapted to the office demanded of it, viz., to keep out of the dark room all the actinic rays which would fog the plates. He began as follows:

The interesting process of emulsions, as published by M. Chardon, requires that in the manipulations a light be employed which has no action upon the bromide of silver. I can render service to those who wish to dabble a little in emulsions, as well as to those who desire to study fully that process, by indicating an easy means how to replace yellow glass, which, unhappily, leaves a passage for a great number of actinic rays. During the last two years in my studies, employing silver bromide for dry-plate work, I have made use of white glass colored by a preparation of aniline to light up my dark room. Among the numerous substances which I tried, one above all has in a high degree the property to arrest the active rays of light. This substance is named "chrysoïdine." Chrysoïdine is a crystallized substance, excessively rich in coloring matter, of a yellowish-red appearance, soluble in water and alcohol, which facilitates its employment in divers matters, such as a varnish to cover a pane of glass, or intermixed with gelatine in order to make a pliable film, or a stain or dye in order to color paper. To make a varnish it suffices to dissolve the powder in a varnish made with alcohol, leave it to cool, and then to filter it; it can then be employed as the ordinary varnish.

Collodion *à la* chrysoïdine is prepared by replacing the alcohol by an alcoholic solution saturated with chrysoïdine. The ether will precipitate a part of the product; it is, therefore, necessary to leave it a certain time to clarify itself, and then to decant it with care.

This preparation, poured upon a sheet of glass as collodion, gives a very strong color, and replaces very advantageously yellow glass as employed at the present day. In some cases it is preferable to cover both sides of the glass with the varnish. One of the best means to utilise this product is make pellicles of gelatine:

White gelatine	308	grains.
Water	1925	"
Chrysoïdine	40	"
Glycerine	46	"
Water containing two per cent. of alum	616	"

Begin by dissolving the chrysoïdine in the 1925 grains of hot water; filter, and allow it to cool. Proceed in the same manner as if you desired to make pellicular negatives by the method of M. Jeanrenaud. It is necessary to have a pellicle as thick as possible, to obtain which, after having covered with talc and collodionized the glass, put a rim round it composed of soft wax. A kind of tray is then obtained, into which the solution of gelatine is poured. The glass is now levelled, and the gelatine left to dry. When dry it is coated with a collodion containing castor oil. If the formula has been carefully followed a pellicle will be obtained of a ruby-red color, which will arrest nearly the whole of the actinic rays of the spectrum.

An excellent anti-photogenic paper can be made by impregnating a thickish white paper with a solution of—

Water	770	grains.
Alcohol	1540	"
Chrysoïdine	47.	"

The paper dyed in this solution can be employed to intercept the actinic rays from entering the dark room for packing all substances liable to be spoiled by white light, such as dry plates, wet and dry emulsions, etc., etc.

A magnificent red dye named "eosine" is equally soluble in water and alcohol, and can be employed in the same manner as chrysoïdine; but, as its power of coloring is inferior to the last-named substance, double the quantity must be employed.

"I was led to employ these different dyes in experimenting with the spectroscope upon the power of absorption of different colors extracted from coal. I will cite the following result, which will show the usefulness of the spectroscope in seeking the actinic properties of different dyes:—

I. FUCHSINE, OR ANILINE RED.

This substance, so well known at the present time, presents a characteristic band of absorption; this band is situated in the green division of the spectrum. If the micrometer of the spectroscope be regulated in such a manner that the division 100 coincides with the yellow rays of sodium, and, at the same time, a small glass tray containing a solution of fuchsine be interposed before the slit of the instrument, a large and sharply-defined band can be seen covering all the part situated between the divisions 110 and 125 of the micrometer. By adding successively more dye to the solution already in the tray, so as to deepen the color, the band of absorption enlarges to the right as well as to the left, covers up the yellow rays of sodium, and finally allows only the orange and red rays to pass, together with a feeble quantity of violet rays. This substance must, therefore, have some influence upon the various preparations in which the sensible salts of silver are employed effectively. It may here be remarked that even a concentrated solution allows a small quantity of actinic rays situated in the violet to pass through. A thick pellicle of gelatine, deeply colored with fuchsine, interposed between the light and a plate prepared with the emulsion of M. Chardon, permits sufficient light to pass through to make a complete positive in fifteen seconds.

II. NAPHTHALINE ROSE.

This substance possesses a band of absorption situated between the divisions 120 and 145. A deeply-tinted solution appears to intercept all the rays except the orange and the red. Although the eye cannot perceive any violet rays, it is possible that by the widening of the band of absorption the violet and the ultra-violet rays of the spectrum can pass. This substance, employed to color a gelatine pellicle, operated upon as in the case of the former dye, gave a positive in sixty seconds.

III. EOSINE.

This dye presents nearly the same properties; the band of absorption is, perhaps, a little narrower. It is situated between the divisions 120 and 140. If no other substance could be found the two last-named dyes might still render service.

IV. CHRYSOÏDINE.

This color presents a great peculiarity, which is that no band of absorption is visible; and if solutions more and more dense be placed before the slit of the spectroscope a kind of screen can be observed, beginning at the violet and advancing towards the division 85 of the micrometer. From this moment, whatever may be the concentration of the solution, the screen advances no further, and the red and orange rays diminish only in intensity.

This peculiar property compels one at first sight to think that chrysoïdine was a perfect anti-photogenic agent, and experiments have confirmed that opinion. An emulsion plate was placed during five minutes behind a pane of glass covered with a gelatine pellicle, deeply colored by chrysoïdine, and gave no trace of an image, although the alkaline development was employed. A pane of yellow glass was experimented under the same circumstances, and a positive was obtained in twenty seconds. This pane of yellow glass had been employed for years in my laboratory in working with wet collodion. Upon being examined by the spectroscope it was found to intercept no ray of the spectrum; it simply enfeebled the light passing through it.

Mr. Brady informed the Society that he had obtained great success with M. Chardon's process.

M. Balaquy developed before the Society some negatives made by the emulsion process of M. Chardon. He employed the alkaline developer, and obtained sufficient intensity with pyro. and carbonate of ammonia.

PHOTOGRAPHY IN AND OUT OF THE STUDIO.

MEASURING THE FORCE OF EXPLOSIVES BY PHOTOGRAPHY.

THE war on the Danube and in the Black Sea calls to mind once more the part which photography has taken in the elaboration of submarine warfare. Most of our readers are acquainted with the earliest use of the camera in connection with torpedo defences, when employed at Venice, where a camera-obscura was used to record the means taken to protect the harbor. Since then photography has been largely employed in this country for ascertaining the comparative explosive power of various compounds under water, and also in impartially recording the amount of damage done by different charges.

It is well known that during the past few years gunpowder has been pushed into the second place, so far as military and naval mining is concerned, and even for industrial and blasting purposes gun-cotton, dynamite, and lithofracteur are nowadays very frequently used, especially in the colonies and America. All these substances are alike chemically—that is to say, that the nitroglycerin which is the active principle of dynamite and lithofracteur is a nitro-compound, and may be considered very much as a liquid gun-cotton. This latter, as every photographer knows, is made by allowing strong acids to act upon cotton, and nitroglycerin is prepared in the same simple manner, namely, by allowing glycerine to fall drop by drop into nitric acid.

In this country we favor gun-cotton for mines and torpedoes, but abroad it is the nitroglycerin compounds which are mostly used. To discover the explosive force of these and gunpowder, picric powder, and several other inventions, photography was employed. In submarine warfare two important points have to be considered, namely, how much water a charge can displace, and how far a cushion of water of a certain thickness is capable of annulling the effects of a shot.

It has been found, namely, that an ironclad is unsafe from the explosion of a heavy torpedo unless a cushion of air of no less than forty feet intervenes between the floating hull and the source of destruction, while a Whitehead or fish torpedo is rendered harmless by a much less interval. The depth at which a charge is exploded has, of course, also considerable influence upon its effects, so far as shock or displacement of water is concerned, and by photography it has been possible to register the various influences exerted by depth in a very striking manner. Every time an explosion of this kind occurs, water is thrown up in the form of a cone, and this cone represents the amount of water displaced.

If you know the measurement of its base, and are acquainted with the height to which the water has been thrown, it remains a comparatively easy matter to calculate the cubical contents of the bulk of water thrown into the air. To register this momentary eruption of water, the camera is brought into play, and with exceedingly good effect, for it is in the main due to the photographic records of these eruptions that the comparative force of the various explosives has been arrived at.

A five hundred pounds charge sunk to a depth of 30 feet, which throws into the air 1,500 cubic yards of water, must obviously have exerted far more energy upon explosion than another of the same height and at the same depth, which only displaces a cone equal to 1,000 cubic yards. In this way we have arrived at the conclusion that gun-cotton is equal, if not superior, to any other explosive, while its use for such purposes is particularly convenient. As we have said, the depth of water materially influences the displacement of water.

Thus a photograph of the explosion of ten pounds of gun-cotton in ten feet of water shows us a graceful cone, or rather column, of water 100 feet in height, but then the base is a very narrow one; while 400 pounds of gun-cotton exploded in 27 feet of water is registered by a photograph representing a column only 80 feet in height, but in this case the base of the volume of water is upwards of one hundred and thirty feet.

We shall not trouble our readers with any more technical details, and have, indeed, only referred to the above to prove the real importance of photography in connection with this modern branch of warfare, and to point once more to the wonderful applications that have been made of the process in the furtherance of war science.

In a stereoscopic view of the America hulk, which we have before us, and which was one of the earliest of the torpedo explosions registered by photography, it is possible to see actually how the hull of the vessel is momentarily poised by the energetic action of the charge, and how the mass is lifted by the destructive agent. There is nothing very wonderful, perhaps, in the depiction of such an event, for photography has since then done wonders for science; but it is a matter, nevertheless, to show how valuable is the art-science in its proper application.

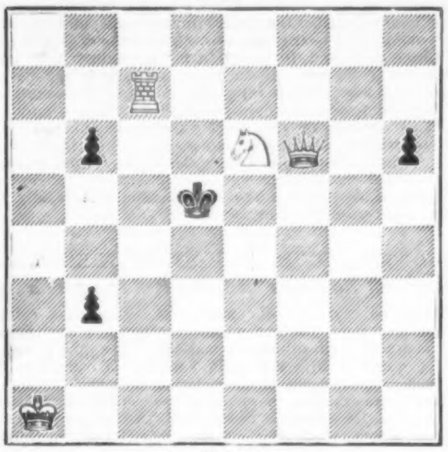
Chevalier, the inventor of the photographic plane-table, had a scheme whereby he hoped to make use of photographic images to enable him to direct the firing of guns as well at night as by day, so that a bombardment might be continued after dark, and the enemy thus prevented from repairing his damages. Whether, had he lived, he would have been able to have brought his scheme to a successful issue now matters little, but we have instances enough before us to show that photography has already materially assisted in war science, and bids fair to render still greater services to the soldier and sailor.—*Photo News.*

SCIENTIFIC AMERICAN CHESS RECORD.

[All contributions intended for this department, may be addressed to SAMUEL LOYD, Elizabeth, N. J.]

PROBLEM No. 9.—CENTENNIAL AMATEUR PRIZE
"C'est Selon."—BY W. A. BALLANTINE.

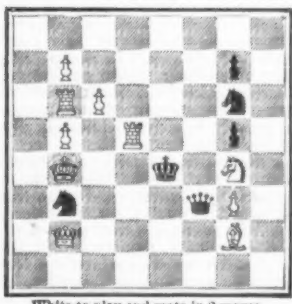
Black.



White.

White to play and mate in four moves.

AMATEUR CENTENNIAL PRIZE.



White to play and mate in 2 moves.
W. A. BALLANTINE.

No prize of the recent Centennial Tournament has created more interest among our problemists than the amateur trophy of a beautiful set of chess men and board offered by Messrs. Selchow & Co., of John street, New York, as a prize for the best problem of the tournament composed by any problemist who had never before competed in a problem tournament. It not only had the desired effect of bringing out a large number of new composers, but has drawn the attention of some of our skillful problemists to tournament matters who had never shown any interest in such contests. I tried to shift the responsibility of this umpireship on to other shoulders for the reason that, having completely withdrawn from these matters for many years, I felt that my recent awakening was somewhat *Rip Van Winkleish*, and I could hardly be expected to be posted as to the status of the rising generation. My colleagues, however, thought it best to make no change, and that, having given the boys a whipping, I should be the one to award the prize.

I will remark *en passant* that my claim to compete for the amateur prize on the ground that I had forgotten all I ever knew, and had to learn the moves afresh, and that the Jersey mosquitoes had got the old blood out of me, has been referred to a special committee, with instructions to report at the next Centennial.

In making the award, I have consulted with several of our problematical experts, who have come to a unanimous opinion, with my own, that the prize is due to Mr. W. A. Ballantine, of this city, for the problem which we publish from his Centennial set, "*C'est selon,*" contributed to the Cleveland *Sunday Voice*.

I give another problem from his set, "*Quod potero fucium,*" contributed to the *Chess Journal*, for the reason that there was an equal division of opinions in regard to the merits of these two problems, which was amicably adjusted, when I informed my colleagues, whose opinions I had solicited, that they had unwittingly hit upon another problem, by the same author, as deserving of the prize. No. 10 would have undoubtedly been the first choice, and would doubtless have ranked high in the Centennial Tournament were it not for a slight blemish in one of the leading variations.

Mr. Ballantine, whose portrait we present to our readers, has long been known as a skillful problemist, specimens of whose compositions will be found in the *Chess Nuts* and early chess publications. He is an enthusiastic admirer of neat and pretty problems, and has strong prejudices against suicidal or conditional positions, as well as difficult or crowded problems, which, I suppose, accounts for his not having taken part in previous tournaments, it being well known that too much weight has been accorded to those features in problematical contests.

As a further speciment of his skill, I select the initial fantasia from one of his competing Centennial letter problems.

S. L.

THIRD AMERICAN CHESS CONGRESS OF 1857.

AT the suggestion of an esteemed correspondent, we give the decisive game between Mr. Morphy and Mr. Paulsen in the first American Chess Congress, held in New York October, 1857.

This tournament will ever be remembered as the great chess era, from which both Morphy and Paulsen date the commencement of their brilliant careers, neither of them having hitherto been looked upon or recognized as leading players.

This tournament was organized upon a very strange, if not unfair, basis. There were four prizes offered, and it was arranged that the players should select antagonists by lot, the loser being thrown out and debarred from all chances of obtaining one of the other prizes.

It is one of the most remarkable coincidences on record, however, that chance should have decided a tournament so fairly. For had Mr. Morphy been pitted against Mr. Paulsen or Mr. Lichtenhein at an early stage of the tournament, those gentlemen would have lost all chance of winning a prize. And yet there is not the slightest doubt that, had the tournament been organized upon the modern plan of requiring each player to contend with every other player, the result would have been the same as chance decided, so far as the three highest prizes were concerned; for no matter how many tournaments might be played, Morphy would always win the first prize, Paulsen would score the second, and Lichtenhein was beyond doubt the third best player.

The matter of Mr. Raphael winning the fourth prize was the only lucky accident of the tournament, as there were many players against whom he would have stood no chance whatever, although we must accord him the credit of having played remarkably well.

The following was the first drawing as well as score of the contestants:

Morphy, 3,	vs.	Thompson, 0.
Raphael, 3,	vs.	Kennicott, 2.
Montgomery, 3,	vs.	Allison, 1.
Meek, 3,	vs.	Fuller, 2.
Marache, 3,	vs.	Fiske, 2.
Lichtenhein, 3,	vs.	Stanley, 2.
Paulsen, 3,	vs.	Calthrop, 0.
Perrin, 3.	vs.	Knott, 2.

SECOND DRAWING.

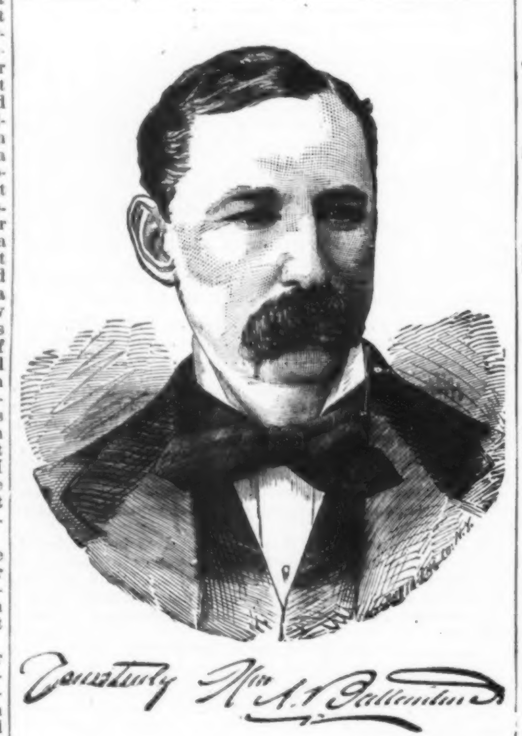
Morphy, 3,	vs.	Meek, 0.
Paulsen, 3,	vs.	Montgomery, 0.
Raphael, 3,	vs.	Marache, 2.
Lichtenhein, 3,	vs.	Perrin, 0.

THIRD DRAWING.

Morphy, 3,	vs.	Lichtenhein, 0.
Paulsen, 2,	vs.	Raphael, 0.

FOURTH DRAWING.

Morphy, 5 (1st prize),	vs.	Paulsen, 1 (2d prize).
Lichtenhein, 3 (3d prize),	vs.	Raphael, 0 (4th prize).



(IRREGULAR OPENING.)

PAULSEN.	MORPHY.
1. P to K 4	1. P to K 4
2. Kt to K B 3	2. Kt to Q B 3
3. Kt to Q B 3	3. Kt to K B 3
4. P to Q 4 (*a*)	4. B to Q Kt 5
5. B to Q Kt 5	5. Kt x K P
6. Q to Q 3	6. P to Q 4
7. Kt x K P	7. Castles
8. Castles	8. Q Kt x Kt
9. Q P x Kt	9. K B x Kt
10. Kt P x K B	10. P to Q B 3 (*b*)
11. K B to R 4	11. Q to Q R 4
12. K B to Kt 3	12. Q x B P
13. Q B to K B 4	13. Q B to K B 4
14. Q R to B sq	14. P to K Kt 4
15. Q x Q (*c*)	15. Kt x Q
16. Q B x Kt P	16. Kt to K 7 ch
17. K to R sq	17. Kt x R
18. R x Kt	18. K R to K sq
19. Q B to B 6	19. P to Q Kt 4
20. P to K B 3	20. P to Q R 4
21. P to Q R 3	21. B to K 3 (*d*)
22. R to Q sq	22. P to Q Kt 5
23. R P x P	23. R P x P
24. P to K R 3	24. P to Q B 4 (*e*)
25. P to Q B 3 (*f*)	25. Kt P x P
26. K B to Q B 2 (*g*)	26. Q R to R 7
27. R to Q B sq	27. K R to Q R sq
28. Q B to Kt 5	28. Q R to R 8
29. K B to Kt sq	29. P to B 7 (*h*)

And Paulsen resigns. This game lasted about six hours.

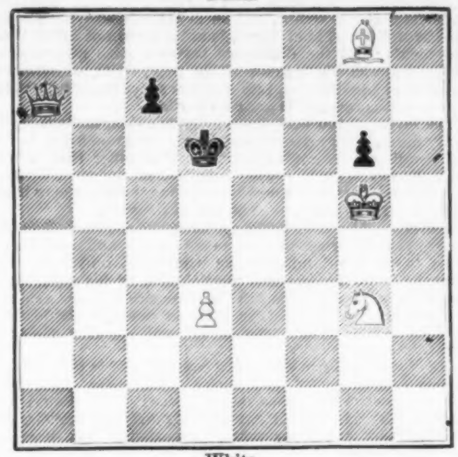
NOTES FROM THE BOOK OF THE AMERICAN CHESS CONGRESS.

(*a*) We should rather prefer 4. K B to Q B 4.

(*b*) Black has not only gained the attack, but must win a pawn immediately.

PROBLEM No. 10.—Quod potero fucium.
BY W. A. BALLANTINE.

Black.



White.

White to play and mate in four moves.

(*c*) Giving up at least the exchange.

(*d*) In order to advance his queen's bishop's pawn.

(*e*) Owing to the strength of the pawns on the queen's flank, black has a virtually won battle.

(*f*) If he ventures to take the queen's pawn with king's bishop, he must lose a piece.

(*g*) If he now captures the queen's pawn, black wins at once, thus:

26. K B x Q P	26. B x K B
27. R x B	27. P to B 7
28. R x B P	28. Q R to R 8 ch,

queening the pawn next move.

(*h*) Winning a price by force, for if—

30. K B x P	30. Q R x R ch
31. Q B x Q R	31. R to R 8,

gaining the bishop.

SOLUTIONS TO PROBLEMS.

OUR space being too limited to give all the variations to the following problems, we give the leading moves, and leave it for the solver to discover the minor variations:

No. 3.—BY S. LOYD.

WHITE.	BLACK.
1. Kt x P	1. B P x Kt
2. Q to Q B 7	2. P to B 5
3. K to Q 2	3. P checks
4. Q x P mate	
	1. K P x Kt
2. P to B 7 ch	2. K to B 6
3. Q to Q Kt 2	3. P moves
4. Q mates	
	1. K to B 5
2. Q to Q R 7	2. K to Q 5
3. Q to R sq ch	3. K to B 5
4. Q to R 4 mate	
	1. P to B 5
2. Q to Kt sq ch	2. K to K 4
3. Q to Kt 3 ch	3. K moves
4. Q mates	

No. 4.—BY S. LOYD.

1. Q to K Kt 5	1. Q to R 8 or K Kt 8
2. Q to K Kt 2	2. Any move
3. Mates	
	1. R to R 2
2. Q to K 3 etc	
	1. R to R 6
2. Q to K 7 etc	

If black play Q to Q 8, or R to R 3 or 5, Kt or B x, and mates next move.

"R."—BY S. LOYD.

1. Q x Q ch	1. K x Q
2. Kt to R 3	2. K to B 6
3. R to Q 3	3. Takes R
4. Kt mates	
2.	2. K to B or Q 4
3. R to Kt 5 ch	3. K to Q 3
4. Kt to K B 4 mate	
	1. K to Q 3
2. R to Kt 5	2. R x R ch
3. K to Kt 2	3. Moves
4. Mates	

TO CHESS CORRESPONDENTS.

MANY valuable contributions of problems and interesting information have been received and filed for future use. We also take this early opportunity of thanking our friends for the same and for their encouraging words, as well as for the flattering notices of the Press throughout the country.

Having received many letters from persons desiring primary instructions in chess, we propose to devote some space to the subject, which we hope to make more clear and practical than can be found in the hand-books, which seem to be more suitable for advanced players.

Our attention has been called to the fact that Dr. Moore's letter "B" of last week's issue should be a three instead of a two move problem.

Our exchanges are teeming with the particulars of the grand chess festival recently held at Leipzig in honor of Herr Anderson. Due notice as well as specimens of his play and problematical skill will be given as soon as our artist has completed a satisfactory portrait of the great German master.